Rhodora

JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Conducted and published for the Club by

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ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
RICHARD ALDEN HOWARD
CARROLL EMORY WOOD, JR.
} Associate Editors

VOLUME 55

1953

The New England Botanical Club, Inc.

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Vol. 55 — January, 1953 — No. 649

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THE NEW ENGLAND BOTANICAL CLUB

Vol. 55 **January, 1953** **No. 649**

THE ELEOCHARIS OBTUSA-OVATA COMPLEX

Henry K. Svenson

Eleocharis ovata has been known as an element of the Eurasian flora, and its recognition as an inhabitant of North America distinct from the ubiquitous *E. obtusa* dates from an account of the group by M. L. Fernald in 1899. His treatment, published in the Proceedings of the American Academy, was initiated by an attempt to identify more clearly the dwarf specimens of the *E. obtusa* group (Gray Exs. no. 138) collected in Purgatory Swamp at Norwood, Massachusetts, and previously determined as *E. obtusa, E. ovata, E. palustris, E. olivacea,* and *E. diandra.* Such differences of opinion not only show the close outward similarity of dwarfed specimens of the genus, but the difficulty encountered when plants have become established in an unusual environment, and have been so contrary as to develop stolons. These specimens finally came to rest under *E. obtusa* var. *jejuna* Fernald, a dwarf form described from North Berwick, Maine, the Purgatory specimens noted as having "spikes more elongated and tubercle narrower than in the extreme form." In Rhodora **31:** 216. 1929, I observed that var. *jejuna* "seems to be an ecological phase which occurs when the plant is growing in muddy inundated places," and it was especially marked in dwarf plants forming turf in a mill pond at Weymouth, Massachusetts (coll. *Fernald & Svenson* in 1928), where there was a succession of flooded and dry conditions. In these specimens the small strongly biconvex achenes had acute greenish tubercles as wide as the achene, and nearly half as high. Let us return to *E. ovata.* This plant is of scattered occurrence in the greater part of central Europe (but apparently not in the British Isles) and extends eastward through Russia to Siberia and the Amur region. It has the outward

appearance of *E. obtusa,* but is inclined to be smaller in stature. The chief difference is in the relative dimensions of the tubercle, ½ to ⅔ as broad as the achene, whereas in *E. obtusa* it is nearly or quite as broad as the achene. *E. ovata* is known from scattered stations in North America from Newfoundland to Washington, usually on lake margins as a sprawling plant with purplish scales, with its greatest frequency in Maine, Vermont, and Minnesota. Within *E. ovata* I included (Rhodora **41:** 43. 1939) *E. diandra,* described from sand-bars of the Connecticut River, and known from several river banks of the northeastern states and differing from *E. ovata* in the depressed tubercle, and reduced bristles. Its greatest concentration is in estuaries, where plants are subjected to alternate flooding and exposure, but it is also known from the sandy eastern margin of Oneida Lake in central New York, where the extensive sand-bars and alternating shallow water provide conditions somewhat similar to those of an estuary.

A recent reexamination by me of the type of *E. Macounii,* known from marshes near Ottawa, makes it clear that this is another of the estuarine modifications of *E. obtusa,* with narrow spikelets in which only a few achenes develop. These vary from biconvex to trigonous, with a tubercle intermediate between *E. obtusa* and *E. ovata,* and with bristles exceeding the achene.

The peculiarity of *Eleocharis* of this group in the Hudson estuary (Rhodora **31:** 211. 1929, and **41:** 43. 1939) has already been mentioned by me in respect to rhizome development and close resemblance to *E. ovata.* Phenomenal variations appeared in collections made by me in September, 1950, at Livingston, Columbia County, New York. The material at the upper level is normal *E. obtusa* (*Svenson* no. 13050A) 2–3 dm. high, with rounded spikelets and achenes 1.25 mm. long and 0.75 mm. wide, including the tubercle which is as wide as the achene. At the intermediate stage of submergence the plants (*E. diandra* 13050D) are smaller (10–15 cm. high), the culms slender, spikelets frequently lanceolate and thin-scaled, achenes 1.2 mm. long and 0.7 mm. broad, the tubercle half as broad as the achene, and most frequently acute, and bristles half as long as the achene or less. At the lowest level, plants (*E. diandra* 13050C) are re-

duced mostly to 5–6 cm., and the spikelets sometimes nearly linear, the achenes as above but bristles usually lacking. Thus there is a series reduced from *E. obtusa* accompanying the various levels. The plants with lanceolate spikelets greatly resemble those of *E. lanceolata* of Arkansas and northern Texas, but are probably not closely related and represent parallel evolution. This situation in the estuaries suggests that Eurasian *E. ovata*, with its narrowed tubercles, has been derived from North American stock, perhaps as the result of changed environmental conditions.

The *obtusa-ovata* group has tenuous limits for determination of species. In fact, all have been considered at some time as variants of the same specific complex, an opinion which may be close to reality. I have seen a few well-developed trigonous achenes in dwarf plants of *E. obtusa* (coll. *B. F. Bush*, Campbell, Missouri, Oct. 26, 1892), which may give a clue to ancestral forms. The tubercle is trigonous with a trilobed base, decurrent on the angles of the achene, much in the manner of *E. pachystyla* of the West Indies, Venezuela, and Colombia, and *E. viridans* of Uruguay. Probably *E. obtusa* comes from the perennial *E. pachystyla*, which it resembles in outward appearance, and the closest derivative of the complex is probably *E. Engelmanni* of the Middle Atlantic and Central States (see map 45, Rhodora **41:** 75. 1939), with a low and frequently somewhat trigonous style-base tending to be decurrent on the angles. *E. monticola* of scattered distribution in the Western States, should be included (cf. Rhodora **31:** 209. 1929) as a variety of *E. Engelmanni*. In the ubiquitous *E. obtusa*, stolon-like branches are occasionally produced toward the end of the growing season, and this is a common occurrence in var. *ellipsoidalis* of quagmires of the Atlantic Coastal plain. A similar condition has already been mentioned as occurring in estuary plants. Throughout its range *E. obtusa* is extremely variable in the size of plants and size and shape of spikelets, these becoming very large in the var. *gigantea* of the western coast, and also in the related *E. Engelmanni* var. *robusta* of southern Missouri. In *E. obtusa* var. *Peasei*, of pond shores in northern New England and Quebec, the achene is without bristles.

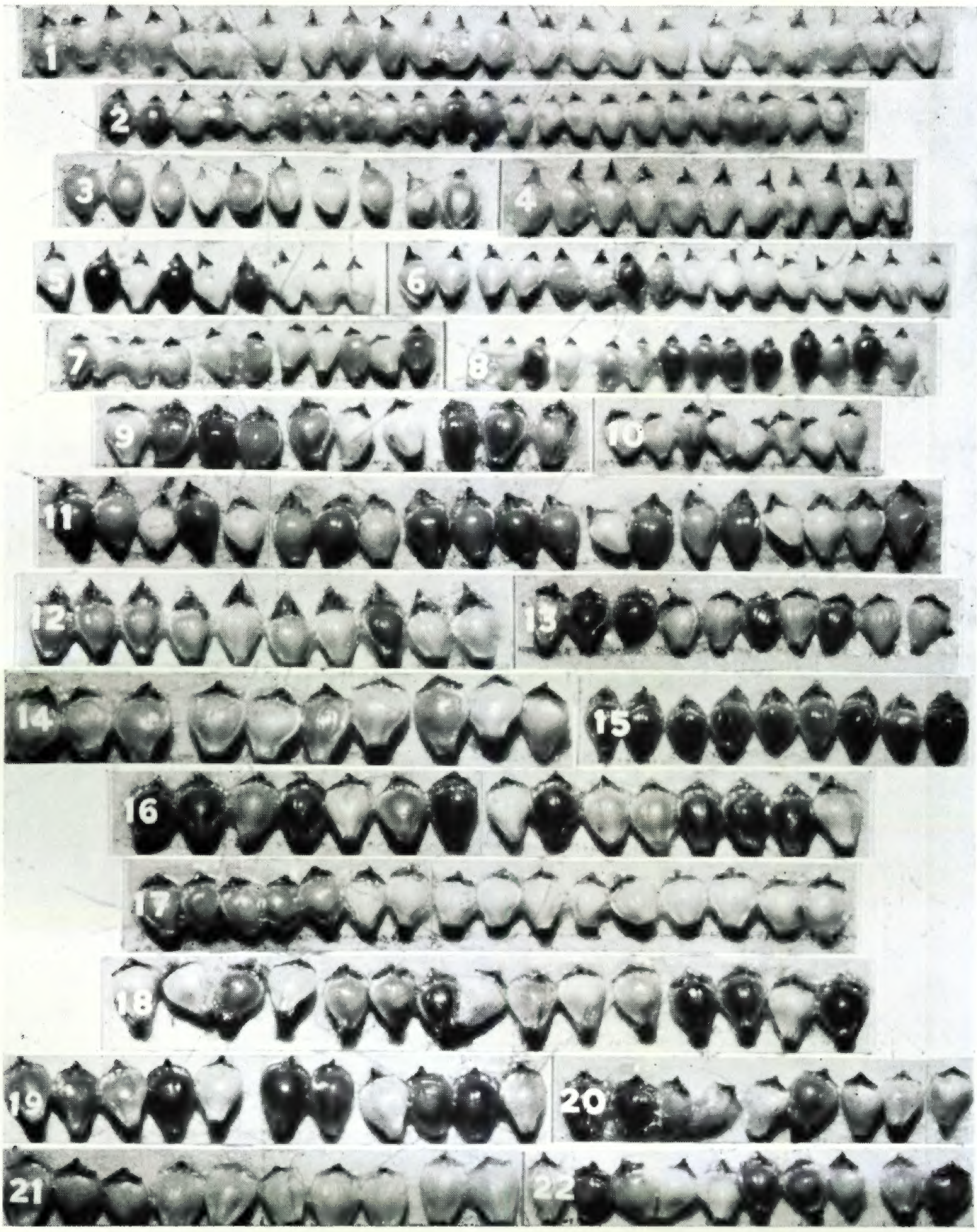
In the seventh edition of Gray's Manual (p. 180), the various species are keyed out as follows:

Tubercle less than two-thirds as broad as the achene.
  Tubercle depressed turban-shaped, broader than high; bristles wanting or rudimentary . . . . *E. diandra.*
  Tubercle deltoid-conic, higher than broad; bristles much exceeding the achene . . . . *E. ovata.*
Tubercle nearly or quite as broad as the achene.
  Tubercle depressed-conic, concaved toward the tip, one-third as high as the achene; bristles much exceeding the achene . . . . *E. obtusa.*
  Tubercle flat-deltoid, with straight sides, one-fourth as high as the achene; bristles scarcely or not at all exceeding the achene . . . . *E. Engelmanni.*

Species in this group have been differentiated on the somewhat arbitrary basis of style-base dimensions in relation to the size of the achene, as may be noted in the cited key to species. Skottsberg (Acta Hort. Gotoburg. **15:** 304–5, figs. 137–147. 1944), in a discourse on Hawaiian material, believes that the difference in width of tubercle (style-base) between *E. obtusa* and *E. ovata* is not so pronounced, and that difference in size of achenes is more decisive. He gives the following figures: for *obtusa* 1.4–1.7 (commonly 1.5) x 0.8–0.9 mm.; for *ovata* 0.9–1.2 (commonly 1–1.1) x 0.6–0.7 (rarely over 0.65) mm.

Though the great mass of specimens of the *E. obtusa* group can readily be determined without trouble, difficulties arise where the variations come in contact, or occur in unusual environments. These annual species of *Eleocharis* can be grown

Explanation of Plate—Fig. 1, Eleocharis ovata *Lakela* 1731, Duluth, Minnesota; 2, E. ovata *Vailleau* 330, France; 3, E. obtusa var. jejuna *Gray Exs.* 438, Weymouth, Massachusetts; 4, E. obtusa *Lakela* 89, Anoka Co., Minnesota, normal E. obtusa; 5, E. ovata *Fernald & Wiegand* 4696, Rushy Pond, Newfoundland, spikelets rounded to elongate; 6, E. ovata *Ziegler* in 1907, Saxony; 7, E. diandra *Bissell*, East Windsor, Connecticut in 1899; 8, E. diandra *Haberer* 1356, Oneida Lake, New York; 9, E. obtusa *Cooper* 89, Anoka County, Minnesota, typical *E. obtusa;* 10, E. ovata *Suksdorf* 2328, Clarke Co., Washington, typical *E. ovata;* 11, E. obtusa *Hermann* 9949, Bowie, Maryland, typical *E. obtusa;* 12, E. obtusa var. gigantea *Macoun* in 1893, New Westminister, British Columbia; 13, E. obtusa *Bickell* 942, Valley Stream, Long Island, New York, small spikelets; 14, E. Engelmanni var. robusta *Demaree* 17714, Logan Co., Arkansas; 15, E. obtusa var. ellipsoidalis *Fernald & Long* 7331, Caprom, Virginia; 16, E. Engelmanni *Steyermark* 22780, Taney Co., Missouri, unusually high tubercles; 17, E. obtusa *Gray Exs.* 138, Norwood, Massachusetts; 18, E. Engelmanni *Metcalf* 589, Socorro Co., New Mexico; 19, E. Engelmanni *Svenson* in 1916, Birch Pond, Saugus, Massachusetts; 20, E. Engelmanni *Kildahl*, Maza, North Dakota; 21, E. Engelmanni *Shreve* 1587, Dorchester Co., Maryland; 22, E. Engelmanni *Rosendahl & Johnson*, Anoka Co., Minnesota in 1917.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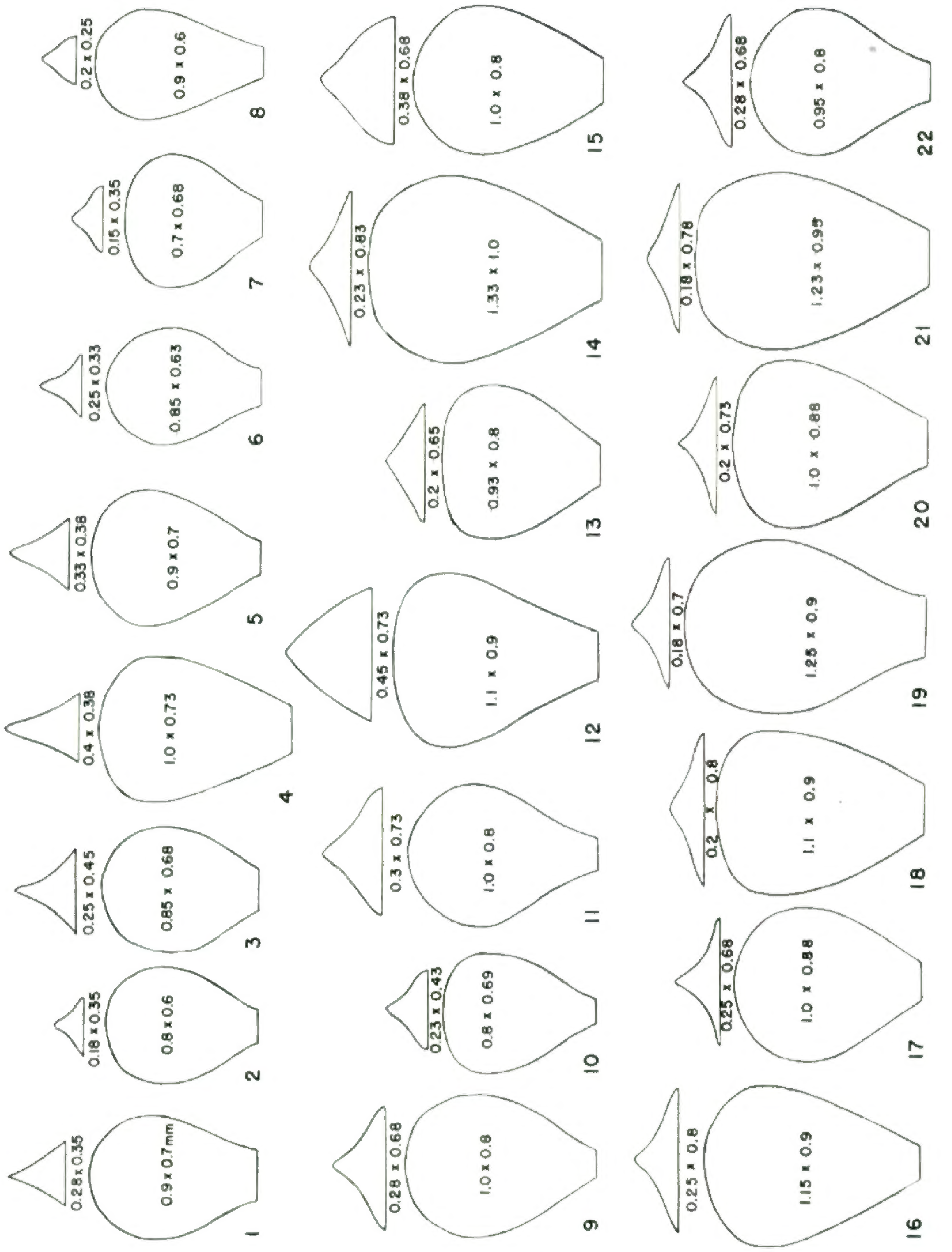

Outlines of achene-body and tubercle representing average dimensions of individual collections shown in Plate 1188.

fairly rapidly in a greenhouse, and experimental and cytological work might perhaps give a clearer understanding of material which is at the border lines. The accompanying photograph was prepared from specimens mounted on a fragment of bristol board, with Lepage's glue as the adhesive. Fassett's use of cellulose acetate (cf. RHODORA **53:** 141. 1951) in a treatment of seeds of *Callitriche*, might be more advantageous, but at best the manipulation of such small structures is not easy.

Where bristles occurred (as in specimens of *E. obtusa* and *ovata*), obscuring the achene-body and tubercle, they were removed together with a minute portion of the base of the achene, by means of fine scissors. I do not think the amount removed from the achene was sufficient to influence the measurements. The slide was photographed and enlarged about 62 ×, and by using a half-millimeter grid-micrometer eyepiece or even a half-millimeter metal rule under a binocular, it was comparatively easy to measure the dimensions of the individual achenes. A few aberrant or poorly mounted achenes were discarded. By adding the measurements and dividing by the number of achenes for each collection, the mean dimensions for tubercle and achene-body were readily calculated. Such photographic enlargements provide a method by which the average or mean dimensions of minute structures can be determined in a manner somewhat similar to the use of "mass collections." Furthermore, the photographic enlargement itself remains as a voucher for the material from which the statistics have been derived. From the mean dimensions of tubercle and achene-body of the individual collections represented in the photograph, outlines of the achenes were drawn up on graph paper and then traced to provide the drawings in the accompanying chart, (Plate 1189) upon which the actual measurements in millimeters are recorded. From these figures the relative achene proportion can be accurately calculated, an analysis of which is provided in the accompanying table.

The average figures for typical *E. obtusa* in the table (achene-body plus tubercle height) are 1.26 x 0.8 (compared with 1.5 x 0.8–0.9 given by Skottsberg); for var. *jejuna*, 1.1 x 0.7 mm.; for var. *gigantea*, 1.6 x 0.9 mm. Most of the Hawaiian material of *E. obtusa* is referable to var. *gigantea*, whereas the achenes of

E. obtusa of eastern United States tend to run smaller. *E. diandra* has achenes approximately the same size as those of *E. ovata*. The ratio of achene width to tubercle width (cf. accompanying chart) is 1.8 x (i. e. nearly twice) in *E. ovata* and 1.3 x (a little wider) in *E. obtusa*, while the achene body in *E. diandra* is 2.1 x (twice as wide). The ratio of height to width of the

	Body	Tubercle		Ratio
	Average (*Ht.*) (*Width*)	(*Ht.*) (*Width*)	(*Ratio*)	*Body Width to Tubercle Width*
E. ovata figs. 1, 2, 5, 6, 10	0.85 x 0.66 mm.	0.25 x 0.36 mm.	1.4	1.8
E. obtusa figs. 4, 9, 11, 13, 17	0.98 x 0.8	0.28 x 0.62	2.2	1.3
E. diandra figs. 7, 8	0.8 x 0.63	0.18 x 0.3	1.7	2.1
E. Engel. figs. 16, 18–22	1.1 x 0.9	0.21 x 0.74	3.5	1.2
E. Engel. var. *robusta* fig. 14	1.33 x 1.0	0.23 x 0.83	3.7	1.2
E. obtusa var. *jejuna* fig. 3	0.85 x 0.67	0.25 x 0.45	1.8	1.5
E. obtusa var. *ellips.* fig. 15	1.0 x 0.8	0.39 x 0.68	1.8	1.2
E. obtusa var. *gigantea* fig. 12	1.1 x 0.9	0.45 x 0.73	1.6	1.2

tubercle of *E. ovata* as represented in nos. 1, 2, 5, 6, and 10 respectively is as follows: 0.28 x 0.35; 0.18 x 0.35; 0.33 x 0.38; 0.25 x 0.33; 0.23 x 0.43. Of these no. 2 and no. 6 are European and they show, as do the American collections which are treated here, that the tubercle really averages wider than high, the ratio being 1.4 ×.

A difficulty in the species problem rests upon the fact that the mind occasionally recognizes the two ends of a continuous series as representing independent species, and tends in such instances to ignore intermediates. Such may be the case between the red and black spruces, *Picea rubens* and *P. mariana*, and every botanist will at once recall other similar situations. Perhaps the same situation exists in respect to some of the complex variations in the difficult *Eleocharis ovata* group, and this treatment should at least provide a background for closer observation of the component elements in critical areas. The American Museum of Natural History, New York.

THE OLD MASSACHUSETTS HERBARIUM

R. E. Torrey and E. L. Davis

In the attic of Clark Hall at the University of Massachusetts there has long been stored an old herbarium which was sent to us from the State House in Boston "many years ago." In 1911, when the senior author was an undergraduate in botany at the College, Dr. George E. Stone, then department head, directed him to go through the collection and to insert loose labels, bringing the names into accord with those of the 7th edition of Gray's Manual. In 1914 Mr. F. G. Floyd visited the college, made a hasty examination of the collection, and identified it as the basis for Item No. 126 in Miss Day's List of Local Floras of New England. This particular item refers to a list of plants cited in the 7th Annual Report of the Massachusetts Board of Agriculture for 1859, printed in Boston in 1860. On page 139, under the heading of "Secretary's Report" (the secretary being C. L. Flint) occurs the following paragraph:

> "Constant efforts have been made to build up the State Cabinet, the object being to make a collection illustrating all branches of the natural history and the agriculture of the Commonwealth, and many valuable additions have been made to it during the past year, the aggregate number of specimens exceeding three thousand.
>
> "It is gratifying to be able to state that the interest in the cabinet has largely increased as its practical value has become more and more manifest. A catalogue of the plants will be found in the Appendix. In other departments the additions, though not so extensive, are nevertheless valuable and interesting."

The "Appendix" to which reference is made occurs on pages III–XII of the same Report; it is headed "Catalogue of Plants," and a preliminary word reads:

> "Most of the plants enumerated in the following list were collected by Dr. Edward Jarvis and Charles Jarvis and deposited in the Cabinet by the former. A portion was collected by Dr. Henry Little of Boston, and presented to the Cabinet by Dr. Charles Pickering. These collections have been examined and arranged by Charles J. Sprague, and owing to the number of duplicate specimens, it has not been thought necessary to catalogue them separately. In addition to the above named collections, many acquisitions have been added during the present year."

Then follows a list of 401 genera and 773 species of vascular plants.

In an article published in Rhodora,[1] Mr. Floyd tells us that the later history of the "Massachusetts Cabinet" had been forgotten until, almost by accident, he learned that the Herbarium had been sent to the Agricultural College in Amherst, where he verified the report by personal inspection. We might mention in passing that the zoological and geological collections appear likewise to have had the same disposal and are now housed in Fernald Hall at the University.

The present State Herbarium, located in Clark Hall, has been expanding in the last decade and just as rapidly as straitened finances make the change possible, is being transferred from old wooden cases to steel ones for safer storage. In the expansion and reorganization, several collections, long stored in the attic for lack of cabinet space, have been incorporated, and the old "Massachusetts Herbarium" has again received attention. Examination showed that some of the specimens were detaching from the sheets, that the writing on the original labels was sometimes faded and close to illegibility, and that specimens had sometimes gotten into wrong folders. Part of the plants are loose in the species folders; others are fastened with strips of gummed paper to a once-folded sheet of primitive-looking paper which is coarse-textured, gray, flexible and deckle-edged. The labels are apparently cut from old letters; they are irregular in shape and wholly inconsistent in size and recorded data. Many bear only the Latin name—rarely the authority is cited, though Linnaeus and Michaux sometimes appear, and we now realize that *Ph.* means Pursh, and *Ew.* means Bigelow. Even the place of collecting, the collector, and the date are all too commonly lacking. "B.G." apparently means "Botanic Garden," and would certainly seem appropriate for a specimen of *Passiflora caerulea* which is so labeled. The collection likewise includes a small set of unsorted garden flowers with no data at all.

In the recent restoration we have made sure that the original labels are securely gummed to the sheets and that every scrap of the original data is preserved. We have also attached a new label bearing (1) the name of the plant as given in the 8th edition of Gray's Manual, and (2) a faithfully typed transcript of the original label. To decipher some of the faded, minuscule, and

[1] Floyd, F. G. The Rediscovery of a Historic Collection of Massachusetts Plants. Rhodora **16**: 185–187, 1914.

often wretched handwriting with the puzzling abbreviations, has required the use of a reading glass and considerable guesswork, particularly as to the proper and place names. The classification, as would be expected, is Linnaean. The numbers 6.3 on a *Lilium* label, for example, obviously means *Hexandria Trigynia.*

After working over the collection for several weeks, the junior author set himself to search for the source and early history of the plants. He has come upon data which show that it is a rather notable historical document for Massachusetts taxonomists.

The first historical reference to the "State Cabinet," of which our Herbarium was once a part, occurs on page 95 in the Report of the Secretary of Agriculture of Massachusetts for 1855, where mention is made of a room in the State House which is being prepared to accommodate it. At this time it already contained several thousand specimens, most of which were minerals. The Report for 1856 (pages 5–6) tells us that such a room has now been provided, but no appropriation has been made to furnish it. The Secretary, C. L. Flint, likewise makes appropriate recognition of the gift of various specimens of grasses during the year. So we may infer that the year 1856 marks the beginning of the botanical collection of the "Cabinet." In the 1857 Report, page 230, we are informed that: "A room has been fitted up to receive the State Cabinet, now of three to four thousand specimens of various sorts." And again the grasses are mentioned, among them "a beautiful specimen of feathergrass from Mrs. Peck of Roxbury."

In 1858, we are given a list of the minerals and birds, and in the "Appendix" the names of Dr. Edward Jarvis and Dr. Charles Pickering are mentioned as "contributing collections which were received too late to list in this Report."

The Report for 1859 is particularly important because we are there told the names of several men, some of whose contributions we have been able to identify from the labels on the sheets. This is the passage which we have already quoted and upon which Miss Day based her Item No. 126.

The Massachusetts Agricultural College was incorporated in 1863, but it was not till October 2, 1867 that the college was

formally opened to students under the presidency of the botanist-horticulturist, Col. W. S. Clark. Once more the Massachusetts Cabinet enters the picture. In the Report of the Secretary of Agriculture for 1866 we find the following record: "Resolved: that the Secretary of the Board be instructed to remove the State Cabinet to the Agricultural College, when the trustees of that Institution indicate to him their readiness to receive and care for the same."

From President Clark's Report to the Trustees for 1867 we learn that the "Cabinet" has apparently survived the journey from Boston to Amherst, and we read: "They have erected a dormitory 100 x 50 feet and four stories high, with a basement for fuel. This edifice, besides rooms for one professor and 46 students, contains two recitation rooms, a reading room and library, and two large rooms occupied by the State Cabinet of specimens illustrating the natural history and geology of Massachusetts."

A picture is given of this building which was called South Dormitory. It was burned in 1885 and on its site stands the present Administration Building.

In 1869 the college purchased the W. W. Denslow Collection of 15,000 specimens of plants, but the old State Herbarium was not incorporated in it—a fortunate circumstance since it would have been hopelessly scattered. Later references in Clark's Reports speak of the danger of destruction by fire and of the great "value of the Collection for purposes of instruction."

We may now turn our attention to the several names which appear on some of the ancient labels, or to those others which we have discovered to be in some manner intimately connected with the old Herbarium. The most important are Dr. Edward Jarvis, Dr. Charles Jarvis, Dr. Henry Little and Dr. Henry Bigelow.

Dr. Edward Jarvis, son of Francis Jarvis and Melicent (Hosmer) Jarvis, was born in Concord in 1803. He graduated from the Harvard Medical School, practiced in Northfield, Massachusetts from 1830 to 1832, resided in Concord from 1832 to 1837; practiced in Louisville, Kentucky from 1837 to 1842, and finally established residence in Dorchester from 1842 to 1884. He published a *Physiology and Hygiene* in 1846, an *Elementary*

Physiology in 1848 and a *Primary Physiology for Schools* in 1849. It is to Edward Jarvis that we must attribute many of our specimens.

Charles Jarvis was the older brother of Edward, and his "C. J." appears on some of the labels. We could discover nothing about him till we finally appealed to the Concord Librarian, Miss Sarah R. Bartlett, who kindly furnished the following information: Charles Jarvis was born in Concord on November 7, 1800. He graduated from Harvard in 1821 and took his medical degree in Boston in 1825. He settled in Bridgewater, but after practicing only three months developed malignant tumor and died in his father's home on February 23, 1826 at the age of 25. It is all but impossible to separate the contributions of the two brothers. Even those which bear the "C. J." initials may have been labeled by Edward after his brother's death. Determinative dates are rare and most of them which occur fall in the 30's. This would mean obviously that they are Edward's contributions.

The following transcripts taken at random show how nicely they correspond to the biography of the Concord Jarvises.

Tilia Glabra (*T. americana* L.), Lime Tree. Bass Wood. Northfield, Bank of Connecticut. (Dr. E. Jarvis practiced there in 1830–32).

Hibiscus Trionum (*H. Trionum* L.), Bladder Petunia. Flower-of-an-Hour. Cultivated Concord, August 1830.

Ornithogalum Umbellatum (*O. umbellatum* L.), Concord, East of Miss J. Heywood's.

Orchis Tridentata (*Habenaria clavellata* (Michx.) Spreng.), Low woods west of Cyrus Hosmer's, Concord with C. Field.

Orchis Blephariglottis (*Habenaria blephariglottis* (Willd.) Hook.) Woods west of Elijah Stevens, Concord, 30th July, 1834.

Potamogeton Natans (prob. *P. gramineus* L.), Probably a variety of the Potamogeton Natans. Found in a ditch in low ground west of Ben Hosmer's barn, near the woods—no flowers, July 30, 1834.

Medeola Virginica (*M. virginica* L.), Craigies wood, 13 June, Cambridge.

Silene Antirrhinum Ph. (*S. antirrhina* L.), Said to be used by Chimney Birds. Viscous below leaves. Hospital Yard. Sandy Soil. June 17.

Alsine media (Nutt.) (*Stellaria media* (L.) Cyrill) Chickweed, Hospital Yard, Boston, 16 June, 1824. [This must be one of Charles' specimens]

There are likewise references to Brighton Meadows; Oak Island; Chelsea; Pine Hill, Medford; Tewksbury; Cambridgeport; Lincoln, near Flint's Pond; etc.

There is a second set of specimens in the Collection whose labels are written in a minute handwriting. They sometimes carry the botanical family name in ornamental lettering and are commonly attributed to "N. H." with the date 1823. Many of them were lying loose among the unattached plants until we decided that for safety they should be gummed to the sheets. We believe that these are the "portion—collected by Dr. Henry Little of Boston, and presented to the Cabinet by Dr. Charles Pickering." Dr. Henry Little is referred to in Bigelow's *Florula Bostoniensis*, 2nd and 3rd editions, as "my pupil, H. Little." Pickering was a practicing physician in Boston who is known to have made botanical excursions in the White Mountains, possibly with William Oakes. He was chief zoologist of the U. S. Exploring Expedition to the South Seas under Lt. Charles Wilkes. Asa Gray likewise refers to these collecting trips to New Hampshire; he attributes the earlier ones to Manassah Cutler, Dr. Francis Boot and Dr. Bigelow, and says that Pickering and William Oakes are believed likewise to have collected in the White Mountains. Since Little was Bigelow's student, it is safe to attribute these plants of 1823 to one of these New Hampshire trips. The following are transcripts of a few of the Little labels:

Ledum latifolium (*L. groenlandicum* Oeder). Labrador Tea. White Hills, N. H. Aug., 1823.

Andropogon furcatus (*A. Gerardi* Vitman), Meadow, N. H. Aug. 1823.

Oxalis acetosella (*O. montana* Raf.), Woods, N. H. Woods on the W. Hills Aug., 1823.

Finally there has come to light another interesting connection with Dr. Bigelow's work. Dr. Jacob Bigelow was a physician at the Massachusetts General Hospital; he was the founder of Mt. Auburn Cemetery, the compiler of a medical botany which passed through several editions, and finally the author of *Florula Bostoniensis*, the 1st edition appearing in 1814. In 1824 he put out a 2nd and enlarged edition of the work, to cover all of New England, while a 3rd edition appeared in 1840. It was the standard New England Manual before Asa Gray's 1st edition of 1848. It is in the 2nd edition, 1824, that numerous acknowledgements are made to Messrs. B. D. Greene and Henry Little for their reports of stations where the plants occur. Some

of these plants have undoubtedly been passing through our hands this summer, as may be inferred from the following parallel quotations:

1. *Fl. Bost.* Edit. 2, 1824. Ranunculus filiformis Mx. Filiform Crowfoot.
   Syn. Ranunculus reptans.
   Low grounds, Topsfield, Bartlett, New Hampshire.
   Label in Old Herbarium (probably by Little):
   R. reptans.
   filiformis Mx. F. B. 224
   Topsfield, near hotel, Aug. 1823
   (Neither R. reptans nor R. filiformis appear in Bigelow's *Flor. Bost.* Edit. 1 of 1814. Little collected it in Topsfield the year before Bigelow's 2nd edition appeared. The line "filiformis Mx. F. B. 224" on Little's label has clearly been added *after the appearance of Bigelow's* 2nd edition in 1824.)
2. *Fl. Bost.* Edit. 2, 1824. Ranunculus Cymbalaria Ph. Sea Crowfoot
   Salt Marshes Chelsea, Cambridge
   Label in Old Herbarium. Ranunculus Cymbalaria
   Chelsea, Brighton, C. River Salt Marsh
   (Ranunculus Cymbalaria is not in *Flor. Bost.* Edit. 1.)
3. *Fl. Bost.* Edit. 2, 1824. Viola debilis Mx.
   Concord Turnpike in Cambridge
   Label in Old Herbarium. Viola Debilis. Moist woods, Concord Turnpike and also from Concord Turnpike, W. Cambridge
4. *Fl. Bost.* Edit. 2, 1824. Arbutus Uva Ursi L.
   Location, Blue Hills, Milton.
   Label in Old Herbarium. Arbutus Uva Ursi
   Blue Hills, Medford
   (There is no mention of the Blue Hills in *Flor. Bost.* Edit. 1, 1814)

In Bigelow's 2nd edition certain species are likewise included which were not mentioned in the 1st edition, and which were found by Little in 1823 though not specifically attributed to him. Such are:

1. *Fl. Bost.* Edit. 2, 1824. Ledum Latifolium—location Monadnock, White Mts.
   Little's label in Old Herbarium. Ledum latifolium, White Hills, N. H. Aug. 1823
2. *Fl. Bost.* Edit. 2, 1824. Ranunculus pennsylvanicus L.
   Little's label. Ranunculus pennsylvanicus from Greenland, N. H., 1823

Many of Bigelow's species of *Rubus* cited as coming from N. H. appear first in the 2nd edition, and our *Rubus* labels by Little carry the term "White Hills," 1823, but without specific names.

But probably the most interesting item in this connection is the following note which Bigelow includes under *Stellaria borealis:* "This plant generally occurs without petals, in which state I discovered it on the White Mt. in July, 1816. I have received it several times from the same place, but always in the apetalous state, until the last year (1823) when Messrs. Greene and Little found it there in August with complete flowers."

Bigelow himself named the plant which has now become the variable *Stellaria calycantha* (Ledeb.) Bong. There is a specimen of it in the Old Collection, and in Little's handwriting we have the words: "White Hills specimen." This doubtless makes it the "type" of the petaloid *S. calycantha.*

We have already noted that Dr. Bigelow refers to B. D. Greene, Esq. of Tewksbury in connection with Henry Little. The following labels bear the initials "B.D.G." and tell their own story:

Andromeda polifolia—Tewksbury. B.D.G.

Trifolium agrarium. B.D.G. (This is a carefully written label bearing a diagram of the flower.)

We can, therefore, infer that Dr. Jacob Bigelow availed himself generously of all these records, and the evidence is conclusive that in the old Massachusetts State Herbarium, once a part of the "Massachusetts Cabinet," we have some of the original plants which passed through his hands in preparation for the 2nd edition of his *Florula Bostoniensis* of 1824, and which were collected by Henry Little, B. D. Greene, and possibly Charles Jarvis. It is an interesting relic of the pre-Grayan systematic botany of New England.—University of Massachusetts, Amherst, Mass.

ANOTHER COASTAL PLAIN RELICT IN THE MISSOURI OZARK REGION

Julian A. Steyermark

Intensive exploration since 1936 of sink-hole ponds in the Missouri Ozarks has brought to light a startling number of plants whose main distribution is confined wholly or chiefly to the Atlantic or Gulf Coastal Plain or its counterpoart of the Mississippi Embayment extension. These ponds, located on top of the uplifted plateau-like Ozark peneplain, are scattered over the more level portions of the plateau, chiefly in the southeastern Ozark counties (See Mo. Bot. Gard. Bull. **39:** 131, 132, and map on pp. 128, 129. June, 1951). One of the species, *Scirpus etuberculatus*,.which in Missouri is known only from a sink-hole pond in Oregon County, occurs elsewhere from Delaware near or along the coast to Florida and west to Louisiana. Other primarily Coastal Plain species, such as *Zizaniopsis miliacea, Eleocharis equisetoides, Scirpus Hallii, Echinodorus tenellus, Nyssa aquatica, Eryngium prostratum, Hottonia inflata*, and *Gratiola viscidula*, are isolated in and around some of these upland ponds. Some of them, such as *Eleocharis equisetoides, Scirpus Hallii, Echinodorus tenellus*, and *Gratiola viscidula*, have not been found in the Mississippi Embayment section of the lowlands of southeastern Missouri or elsewhere in the state, whereas others, such as *Zizaniopsis miliacea, Nyssa aquatica, Eryngium prostratum, Hottonia inflata, Hydrolea uniflora, Hedyotis Boscii, Cephalanthus occidentalis* var. *pubescens*, and *Pluchea foetida*, are otherwise known only from the Mississippi Embayment section of southeastern Missouri. Associated with the species of primarily southern and Coastal Plain affinities are others ranging farther northward, but in Missouri occurring only around the sink-hole ponds. Among these may be mentioned *Najas gracillima, Potamogeton pulcher, Potamogeton epihydrus* var. *Nuttallii, Glyceria acutiflora, Carex alata, Carex decomposita, Carex straminea* Willd. (not *C. straminea* sensu Mackenzie nor of Gray's Manual, 7th edition), and *Decodon verticillatus*.

Of particular phytogeographical significance, therefore, is the discovery of another typical Coastal Plain species from the vicinity of one of these sink-hole ponds. I refer here to *Eupa-*

torium hyssopifolium L., var. *calcaratum* Fern. & Schub., a collection of which I have carefully studied in comparison with other herbarium material. The range of typical *E. hyssopifolium* is given in the eighth edition of Gray's Manual as "Fla. to e. Tex., n. to s. R. I., L. I., N. J. and Md." and for var. *calcaratum* as "Dry open woods and clearings, on or near Coastal Plain, Ga. to Tex., n. to se. Mass., R. I., Ct., se. N. Y., N. J., Pa. and Md." My collections were made from dry open places bordering a sink-hole pond in southern Missouri. The surrounding upland has a more level and unbroken appearance than the more characteristic rugged and dissected topography usually associated with the Ozarks.

Like *Scirpus etuberculatus*, this interior Ozark station for *Eupatorium hyssopifolium* var. *calcaratum* is isolated by a thousand miles or more from its nearest Coastal Plain habitat. Species with which *Eupatorium hyssopifolium* var. *calcaratum* was associated are *Ilex decidua*, *Eryngium prostratum*. *Diodia virginiana*, and *Pluchea foetida*, whose distributions are mainly found in the Gulf and Atlantic Coastal Plain areas and the Mississippi Embayment section.

Specimens of the collection have been deposited in the Chicago Natural History Museum Herbarium, Gray Herbarium, and Missouri Botanical Garden Herbarium. The data for the collection of *Eupatorium hyssopifolium* var. *calcaratum* in Missouri is, dry open places bordering Twin Ponds, east of highway A, T 23 N, R 8 W, NW ¼ sect. 16, in dry upland, 4 miles south of West Plains, Howell County, September 3, 1949, *Steyermark 69063*.

The occurrence of this isolated Coastal Plain plant in the dry interior of the Ozark highlands is comparable to the occurrence of some of the stranded Coastal Plain relicts found on the Cumberland Plateau and elsewhere in the eastern United States. Present studies based upon the author's explorations of numerous sink-hole ponds during the past decade and a half indicate that the Missouri sink-hole ponds represent the last remnants of parts of the swampy peneplain that formerly existed in the state prior to the last uplift of this peneplain area at the end of the Tertiary Period. The drainage of these ponds is connected with that of underground streams flowing eventually southeastward into the Mississippi River or Mississippi Embayment, or southward into

the White River drainage, the latter eventually connecting with the drainage of the Mississippi River. As the Tertiary uplift of the Ozark region gradually changed the peneplain from a region of sluggish streams and swampy habitats to the present upland topography with its rocky drier soils and dissected well-drained topography, the formerly more abundant aquatic and sub-aquatic habitats of the swampy peneplain became more drained and eventually were reduced to a relatively few localities centering around the present sink-hole ponds. After Pleistocene times the Xerothermic period must have further reduced the occurrence of strictly aquatic habitats, exterminating Coastal Plain and other species that had survived from the end of the Tertiary uplift.

These sink-hole ponds give every evidence of having served for aquatic habitats in the past and at present they afford a refuge in the Ozarks by being the last remaining habitats suitable for Coastal Plain and Mississippi Embayment species. Botanically, therefore, they represent probably the most significant relict habitat in the Ozarks, dating back to the close of the Tertiary Period, and the species isolated in their distribution to these ponds are in Missouri certainly to be considered as among the oldest, if not the oldest, elements in the flora of the state.—CHICAGO NATURAL HISTORY MUSEUM AND MISSOURI BOTANICAL GARDEN.

ADDITIONS AND EXTENSIONS TO THE FLORA OF NOVA SCOTIA

J. S. ERSKINE

THE following records of collections were made, chiefly during 1950–51, while collecting for the Nova Scotia Museum of Science. To avoid repetition, new records for Cape Breton were included in the recent paper by Dr. E. C. Smith (RHODORA **54**: 220. 1952).

LYCOPODIUM SELAGO L. Amethyst Cove, King's County. First record for mainland.

SPARGANIUM HYPERBOREUM Laest. New Harbour, Guysborough County. First record for mainland.

BROMUS TECTORUM L. Common on railway ballast around the railway station at Berwick, King's County. Confirmed by W. G. Dore of the Dominion Experimental Farm, Ottawa who

says: "This approaches var. *glabratus* Spenner in its glabrous glumes and scabrous lemmas. The weed that is common in southern Ontario and southern Alberta is quite hispid to pilose on the spikelets. It would appear that your collection, which is the first I know of from Nova Scotia, has been an introduction from a source not in the interior of Canada. Our two collections from New Brunswick (St. Andrews 1936 and Fredericton 1934) are both of the typical hairy kind."

Eragrostis poaeoides Beauv. This was found growing on railway ballast at Truro, Colchester County, *E. C. Smith et al. 4809*, and at Wolfville, King's County, *D. S. and J. S. Erskine JSE 51.1532*. It was determined by W. G. Dore.

Panicum clandestinum L. Gaspereau River, King's County; Shubenacadie River, Halifax County; St. Mary's River, Guysborough County. Eastward extension of range.

Rhynchospora capitellata (Michx.) Vahl. Abundant in flood-plain of St. Mary's River at Caledonia, Guysborough County. Extension from southwest corner of province.

Stellaria Holostea L. Reported in error (Rhodora **53**: 268. 1951) by D. S. Erskine from a record of mine.

Sanguisorba officinalis L. A long-established but not large station of this plant was found between a meadow and an oxbow pond beside the St. Mary's River, some four miles above Sherbrooke, Guysborough County (*JSE 51.570*). This seems to be the first record for Canada.

Dirca palustris L. A single sterile bush of this species was found on the Newport "chimneys," a network of gypsum sink-holes shaded by spruce beside the St. Croix River, Hants County. No material for comparison was locally available, however D. S. Erskine, after looking up material of this species in the University of Toronto herbarium, thought our collection was accurately determined. Since then W. B. Schofield has found in some unpublished material of Macoun's in the National Museum at Ottawa a report of the finding by Dr. Soloan and his students of three stations of this plant in Nova Scotia. This was unsupported by collections and the definition of locality was vague, e. g. "Wentworth." There is a "Wentworth" within three miles of our new station for *Dirca*, but there are also others in the province.

Epilobium angustifolium L., f. albiflorum (Dumont) Haussk. One white flowered plant among typical, *R. Erskine*, Sandy Cove, Digby County, 9th August 1948.

Asclepias incarnata L., var. neoscotica Fern. Headwaters of Gay River, Halifax County; Whycocomagh and Black River, Inverness County. The three varieties of the species, *neoscotica*, *typica* and *pulchra*, are all found here and do not separate satisfactorily. Each colony found seemed to have minor differences nearly as important as those of number and size and pilosity of leaves. The station at Gay River was sterile or in flower; that at Whycocomagh two days later was wholly in fruit or sterile; those at Black River three days after that were sterile or in flower, but the most typically *neoscotica* were usually browsed off while the clumps protected by banks of *Crataegus* were tall and approached var. *pulchra*. It would be interesting to have an experimental taxonomist subject these varieties to poor soil and periodic browsing in order to determine to what extent these differences are environmental.

Gratiola aurea Muhl. Lake Charlotte, Halifax County; Gaspereau Lake, King's County. Minor extensions.

Campanula aparinoides Pursh. Near mouth of Economy River, Colchester County (*JSE 51.145*). Second station for province.

Eupatorium maculatum L., f. Faxoni Fern. Two plants in marsh at Whycocomagh, Inverness County (*JSE 51.822*).

Solidago flexicaulis × macrophylla. *S. macrophylla* Pursh is common in Cape Breton but is rare on the mainland. Two collections have been made in Colchester County from the Economy River valley (*E. C. Smith et al. 1208; JSE 51.163*). The author found a single flowering plant at Amethyst Cove, King's County, (*JSE 51.1652*), growing among abundant *S. flexicaulis* L., while another single plant (*JSE 51.1654*) combined the characters of both species, having the size and long-branched inflorescence of *macrophylla*, the shorter petioles and less coarse serration of leaf and small heads of *flexicaulis*. As Gray's Manual does not include this among *Solidago* hybrids observed, it may be worthy of note.

Crepis capillaris (L.) Wallr. Well-established in a pasture half a mile northeast of the much collected Villagedale Dunes, Shelburne County (*JSE 51.1467*). New to the province.

Grateful acknowledgements are due to the Nova Scotia Museum of Science for financing the collecting and to Dr. W. G. Dore and Dr. B. Boivin of the Dominion Experimental Farm, Ottawa, for determinations of plants new to the province.
Wolfville, Nova Scotia.

Podophyllum peltatum forma Deamii Raymond in Western Pennsylvania.—These plants grow in open white-oak woods with an understory of sassafras and flowering dogwood, near Criders Corners in Butler County, just across the Allegheny County line. They occur in a large patch which is twelve feet in the longest dimension and contains fifty or more plants, all of which have the maroon colored (dark vinaceous of Ridgway) fruits and blush-pink blossoms. Nearby and scattered throughout the woods are many other patches, all of which are the ordinary yellow-fruited kind.

This patch was first discovered on June 27, 1943, by A. J. Deer, W. E. Buker, and F. H. Beer, at which time a specimen was taken and presented to the Carnegie Museum Herbarium. The specimen was filed as a color variant of *P. peltatum*. When Dr. Raymond's form was described in 1948, we found that our specimen checked exactly with his description of forma *Deamii*. The form was included in the "Check List of the Vascular Flora of Allegheny County, Pennsylvania," published by the author and Mr. Buker in 1951, since we also listed species not yet found within the County but collected within a ten-mile radius of the boundary.

On June 5, 1952, Mr. Buker and the author visited the patch again in order to collect some specimens for exchange. It seems likely that all the plants have been derived from a single mutant parent by rhizomatous growth, since digging revealed that several plants were connected to one rhizome. The coloring of the plants and the immature fruits was as follows: tip of rhizome bud, dark vinaceous (Ridgway); base of stem, dark vinaceous; remainder of stem and the petioles, flecked with same color; peduncles maroon (Ridgway); and immature fruits dark vinaceous.—L. K. Henry, Curator of Plants, Carnegie Museum, Pittsburgh.

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A FLORISTIC STUDY OF COOK COUNTY, NORTHEASTERN MINNESOTA[1]

FRED K. BUTTERS[2] AND ERNST C. ABBE

"The face of the country offers a wild scene of huge hills and rocks, separated by stony vallies, lakes and ponds. Wherever there is the least soil, it is well covered with trees."

Alex. Mackenzie.

Mackenzie's (1802) succinct characterization of the Border Lakes country of Cook County, although cast in the romantic verbiage of another century, describes this region as it still exists today (Plate 1190-A). Mackenzie was travelling by canoe along the old fur-traders' route between Grand Portage (Fig. 1), the famous fur-trading center, and the height of land. He was by no means the first white man to visit the region—it had been known and the route had been in use for over a hundred years before his time (*cf.*, *inter alia*, Nute 1941 and 1944).

The writers' interest in Cook County was initiated when Dr. Butters discovered certain of the floristic rarities of Lake Superior at Grand Portage in 1927. These rarities had long been known from the adjacent Thunder Bay and Algoma Districts of Ontario, thanks to Louis Agassiz's canoe expedition of 1849 (Agassiz, 1850). The collections of Juni (1879) and of Roberts

[1] The Graduate School of the University of Minnesota has, since 1938, periodically supported the field work upon which this study is based; it also awarded the junior writer a Faculty Summer Research appointment, second summer session, 1947, to permit the rewriting of Sections 9–12. Completed with aid from the National Science Foundation (Grant NSF-G111).

The Junior Hayden Fund of the Department of Botany, University of Minnesota, has provided the funds for extra pages and plates.

[2] The untimely death of Fred K. Butters in 1945 (*cf.* Abbe, 1948) left Sections 1–11 unwritten, although Section 12, the Annotated List, was virtually complete at that time. The junior author has attempted to embody in Sections 1–11 the essence of many conversations with Dr. Butters, but must accept full responsibility for all errors of omission and commission.

(1880) extended the known range of these floristic elements along the North Shore of Lake Superior into Minnesota, and focussed attention on "The Point" at Grand Marais. It had also been known for some time (*cf.* Cooper, 1913; and Brown, 1937) that Isle Royale also shared in the presence of these floristic curiosities. Although Fernald (1925) in his classical phytogeographical study seemed to have established a comprehensive hypothesis—the "Persistence" theory—to explain the presence of such oddities in the flora of eastern boreal America, doubts began to develop. Dr. Butters' skepticism of the "Persistence" theory had its roots in his studies of the Selkirk flora (Butters, 1914); that of the junior writer in his study of the flora of northeastern Labrador (1936). In 1937 the writers presented an oral report (Butters and Abbe, 1937) on the flora of Cook County based on their field work of 1936 and 1937, and there raised questions concerning relations of the flora to the history of the Pleistocene in the area. It is impossible to attribute the presence of any plants in the county today to "survival"—the necessary "refugia" do not exist. The present paper is the culmination of the work reported in 1937, extended to include a catalogue of the vascular plants of Cook County. It is organized into twelve sections as follows:

1. Surface Features
2. Geological Features
3. Climate
4. Summary of environmental conditions in Cook County
5. General Features of the Flora and Vegetation
6. The localized habitats and their plants
7. Presumed history of the flora of Cook County
8. Comparison with other presumed "nunatak" areas
9. The botanical exploration of Cook County
10. Summary of major collections from Cook County
11. Place names in Cook County
12. Annotated List of Vascular Plants of Cook County

Acknowledgments.—Especial thanks for constructive discussions are due Dr. H. M. Raup of the Harvard Forest, Dr. Rolla M. Tryon, Jr. of the Missouri Botanical Garden, Dr. R. P. Sharp of the California Institute of Technology, and to Drs. W. S. Cooper, D. B. Lawrence, G. B. Ownbey and H. E. Wright, Jr. of the University of Minnesota.

1. Surface Features[3]

Cook County, as part of the Arrowhead region of northeasternmost Minnesota, falls at the western limits of the great Laurentian Upland. The relief in the county is the greatest for any part of the state, ranging from the shores of Lake Superior (602 ft.) to the tops of the Misquah Hills (2230 ft., maximum elev.) in the central part of the county (Fig. 2 A).

A number of more or less isolated "mountains"—the Sawteeth Mountains—mark the southern edge of the rolling tableland which constitutes the greater part of the county. The easternmost of these hills is Mount Josephine and one of the westernmost, Carlton Peak. The Sawteeth Mountains rise rather abruptly from the shore of Lake Superior to slightly above the level of the extensive tableland whose elevation is about 1500 feet.

On the abrupt rise from the lake to the tableland there occur many raised beaches interspersed among the numerous wave-cut cliffs. These features represent the abandoned shorelines of the late-Wisconsin predecessors of Lake Superior. The beaches are more frequent in the eastern part of the county; they are variously composed of gravel, shingle, and cobbles, as are the present beaches. There are very few sand beaches along the present northwestern shores of Lake Superior, the shores in general being too abrupt and rocky to favor their establishment.

The rolling topography of the tableland is reflected in the drainage (Fig. 1). The streams and rivers of the southern part of the tableland flow gently southward in shallow valleys, interrupted occasionally by lakes until they reach the edge of the tableland. Here they tumble precipitately over the edge of the tableland. From the edge of the plateau to the level of Lake Superior short but deep canyons have been formed by this active stream action.

The height of land between the Lake Superior drainage and the Hudson Bay drainage runs diagonally across the western portion of the tableland (Fig. 1). There is, however, but little difference in aspect between the two portions of the tableland on either side of the height of land.

The northeastern part of the tableland is markedly different from the rest (Plate 1190-A). The streams and deep lakes (100–

[3] See fig. 1 and 2.

200 ft.) here lie in the Pigeon River drainage which is part of the Lake Superior system. Both the rivers and the lakes have a predominantly east-west orientation and there is a striking cuesta type of topography (*cf.* Fig. 2 B). Associated with the latter there are numerous shady north-facing cliffs which often rise several hundred feet above the lakes at their bases. Extensive talus slopes are usually formed at the bases of these cliffs. Smaller cliffs have in many places been engulfed by the encroaching and finally stabilized talus. The talus of the larger cliffs, on the other hand, is still growing slowly due to occasional rock falls as weathering of the cliff faces continues. At the bases of the great talus slopes are rectangular diabase blocks eight or ten feet on a side, while farther up the slopes the blocks become smaller and may give way to elongate shards of slate; at the bases of the rock walls of the cliffs the soil is a finely comminuted rock. The diabase trap sills which form the caps of the north-facing cliffs slope gently southward to the next chain of lakes. These are set off by yet another series of north-facing cliffs, a sequence which is repeated until the southern limit of the Rove Slate area (Fig. 2 C) is reached.

According to earlier estimates (*cf.* Leverett and Sardeson, 1917) fully 25% of the 1680 or so square miles of the surface of the county is occupied by lakes (Fig. 1) and muskeg. This is probably too low a value, but a more accurate estimate awaits evaluation of the aerial survey maps. The muskegs and swamps are especially abundant on the greater part of the upland and in the lowlands at the eastern end of the county. These muskegs are often intimately associated with existing lakes, both occupying rounded basins formed in the underlying rock and morainic materials. In the Rove Slate area, muskegs are, however, very infrequent, the deep V-bottomed lake basins being poorly adapted to muskeg development.

Unlike most of the rest of the state there are extensive areas of bare rock exposed in Cook County. The higher hills are generally rocky and scoured by glacial action and there are many intervening areas of exposed rock. Many of the streams entering Lake Superior have cut down to bed rock in the more precipitous portions of their courses. Notable rock exposures also occur in the great cliff faces of the Rove slate area (Plate 1190-A).

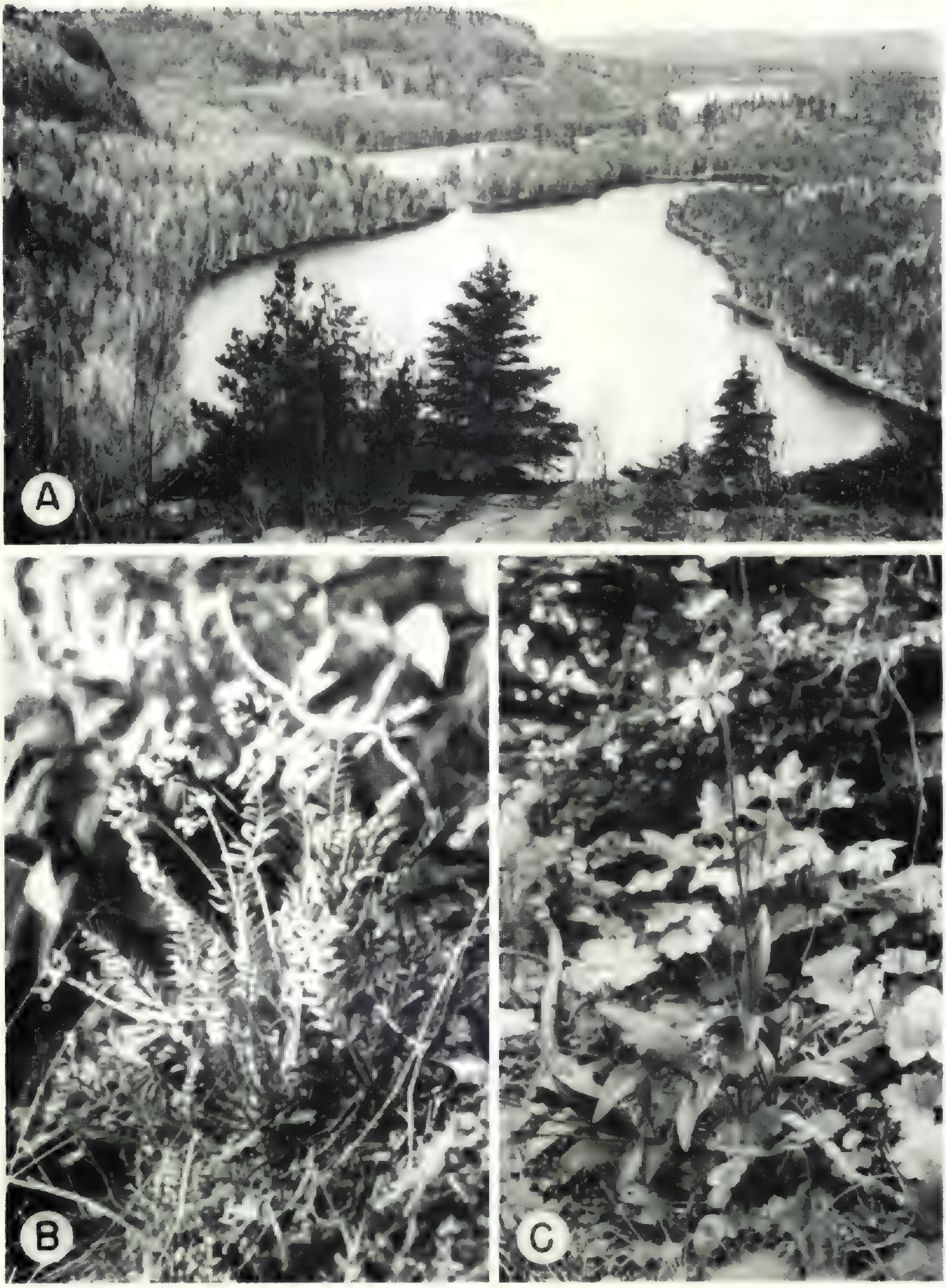

Plate 1190. A. View looking westward in Rove Slate area of the Border Lakes region, Rove Lake in the foreground; B. *Oxytropis ixodes* on talus, South Fowl Lake, type station; C. *Arnica chionopappa* at Clearwater Lake.

Plate 1191. Lake Superior shore types in the Susie Islands; high rocky shore in foreground, low rocky point in background.

Relatively bare rock surfaces characterize much of the lake shore (Plate 1191), becoming fairly extensive on the wave-washed points.

Residual material other than that of glacial origin is limited in extent. However, some phases of the Duluth gabbro, in areas only recently exposed by the retreating waters of Lake Duluth, (Fig. 3D) have already developed areas of raw regolith, or disintegrated mantle rock, due to post-glacial weathering.

Glacial deposits cover great areas of the county. These take the form of outwash, ground moraines and lake plains. They vary from the finer sediments of the lacustrine clays formed under the waters of Lake Duluth and its successors to coarse boulder trains on parts of the upland.

2. Geological Features

a. The Bedrock Geology. The bedrock geology of the county has been discussed at considerable length in a number of publications by members of the Department of Geology of the University of Minnesota. Publications by Grout and Schwartz (1933 and 1939) and by Gruner (1941) form the basis for the following summary.

In fig. 2, C and D, there are summarized the salient features of the structural geology of the county. In the northwesternmost part of the county there are exposed the Saganaga granites and Ely greenstones of Archean age which are overlain by agglomerates and conglomerates of the Knife Lake series of Algonkian age. These rocks are overlain unconformably by the Gunflint iron formation and the Rove slates, which are exposed in the rest of the northern third of the county. The Rove slates are overlain and intruded by flows and intrusives of the Keweenawan series, which extend eastward to Lake Superior. The presumed historical sequence of events is graphically described by Gruner (1941, pp. 1638–40) in his paper on the Knife Lake series.

The importance of the bedrock geology lies both in its influence on the topography and on the till and soils derived from it.

Zumberge (1952) devotes considerable attention in his study of Minnesota lakes to the bedrock control of topography in the Border Lakes region. He emphasizes the fact that the relative absence of glacial deposition in the area permits a full expression

of the interplay between glacial erosion and bedrock geology. In the Saganaga granite area (Fig. 2 C) many of the lakes (Fig. 1) have linear segments related to the rock joints. In the Duluth gabbro the lakes tend to be elongate because of the differential erosion of the banded gabbro. In the Rove slate area the east-west valleys are in troughs eroded in the slate exposed between successive layers of diabase (Fig. 2B). Here, unlike the rest of the county, there are sharp ridges between the lakes. The edges of the diabase caps over the Rove slates are responsible for these ridges, which slope gently to the south, but have precipitous northern faces rising from 200–400 feet above the lakes. The abruptness of the faces of these cliffs is maintained by the rapid weathering of the slate underlying the diabase. Slate shards form the upper part of many of the talus slopes while the coarse diabase blocks falling from the brows of the cliffs tend to accumulate at the bottoms of the talus slopes. Phytogeographically, these cliffs are significant because their active weathering and the moving material of the talus prevents the establishment of forest until late in the physiographic history of the cliffs.

The relation of the bedrock geology to the nature of the drift and to the soils of the county in its broad aspects is fairly clear. At one extreme lie the Saganaga granites which produce an acid medium for growth, and one which seems low in availability of the nutrients required by many plants; at the other extreme lie the Rove slates which tend toward the calcic, as do some phases of the gabbro and diabase, favoring the growth of calcicoles.

b. Glacial Geology.[4] The riddle of the re-population of Cook County by plants is intimately inter-related with the recent glacial history of the county. Two questions arise, one, when did the surface of Cook County first become available for plant immigrants, the other, what was the nature of the terrain and presumed climate which greeted the newcomers? For our purposes it is desirable to try to reconstruct the sequence of events in northeastern Minnesota generally as the background

[4] The junior author is deeply indebted to Dr. R. P. Sharp for his generosity in making available as yet unpublished information (Sharp, in prep.) derived from his field work in Cook County during the summers of 1946–47. Most of the material in this section is adapted from his manuscript. Dr. H. E. Wright, Jr. has contributed much unpublished material from his work (Wright, in prep.) on the Superior Lobe. Neither Dr. Sharp nor Dr. Wright is responsible for possible error of statement here.

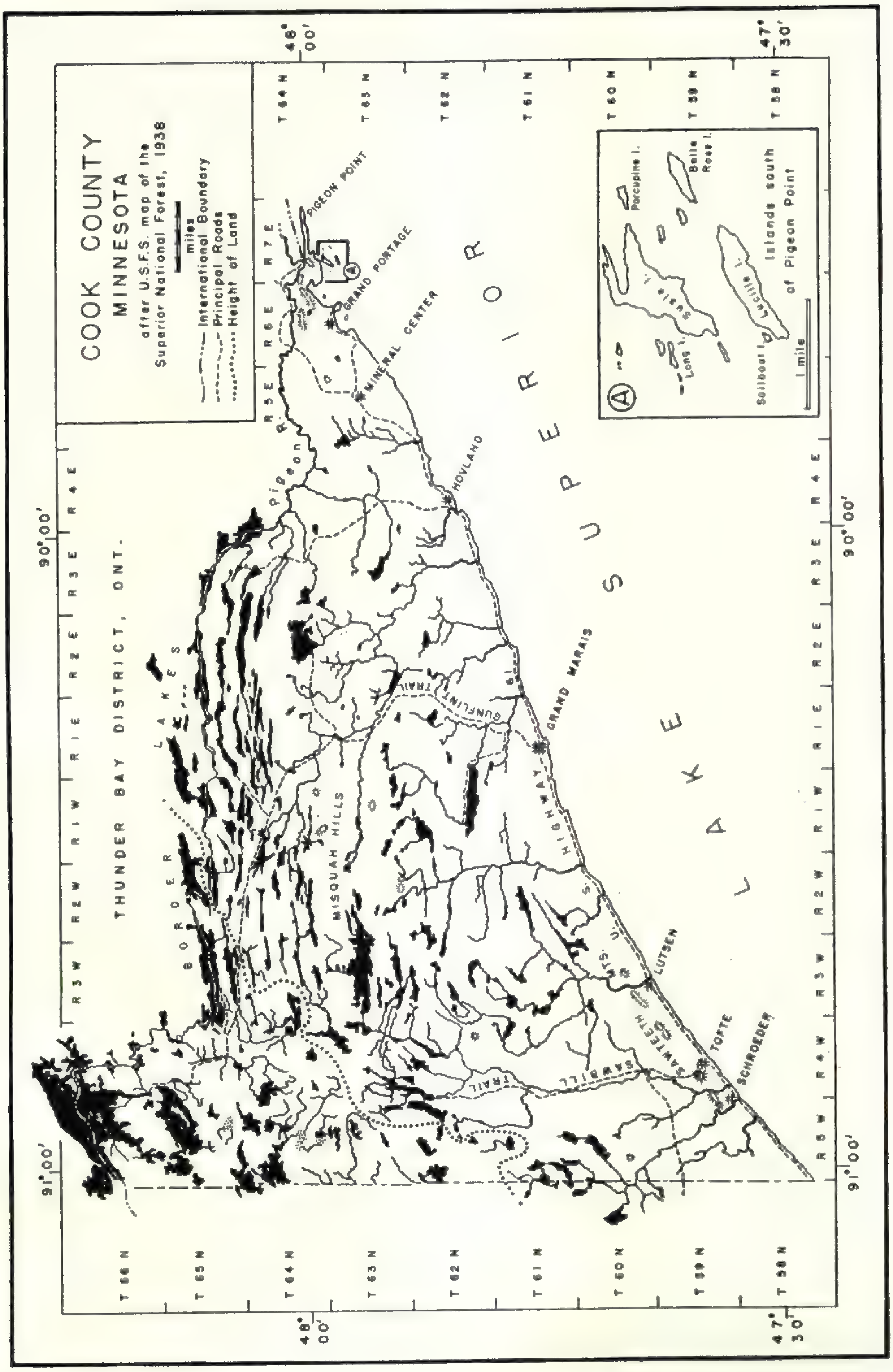

Fig. 1. Outline Map of Cook County; Inset A shows the Susie Islands in fuller detail.

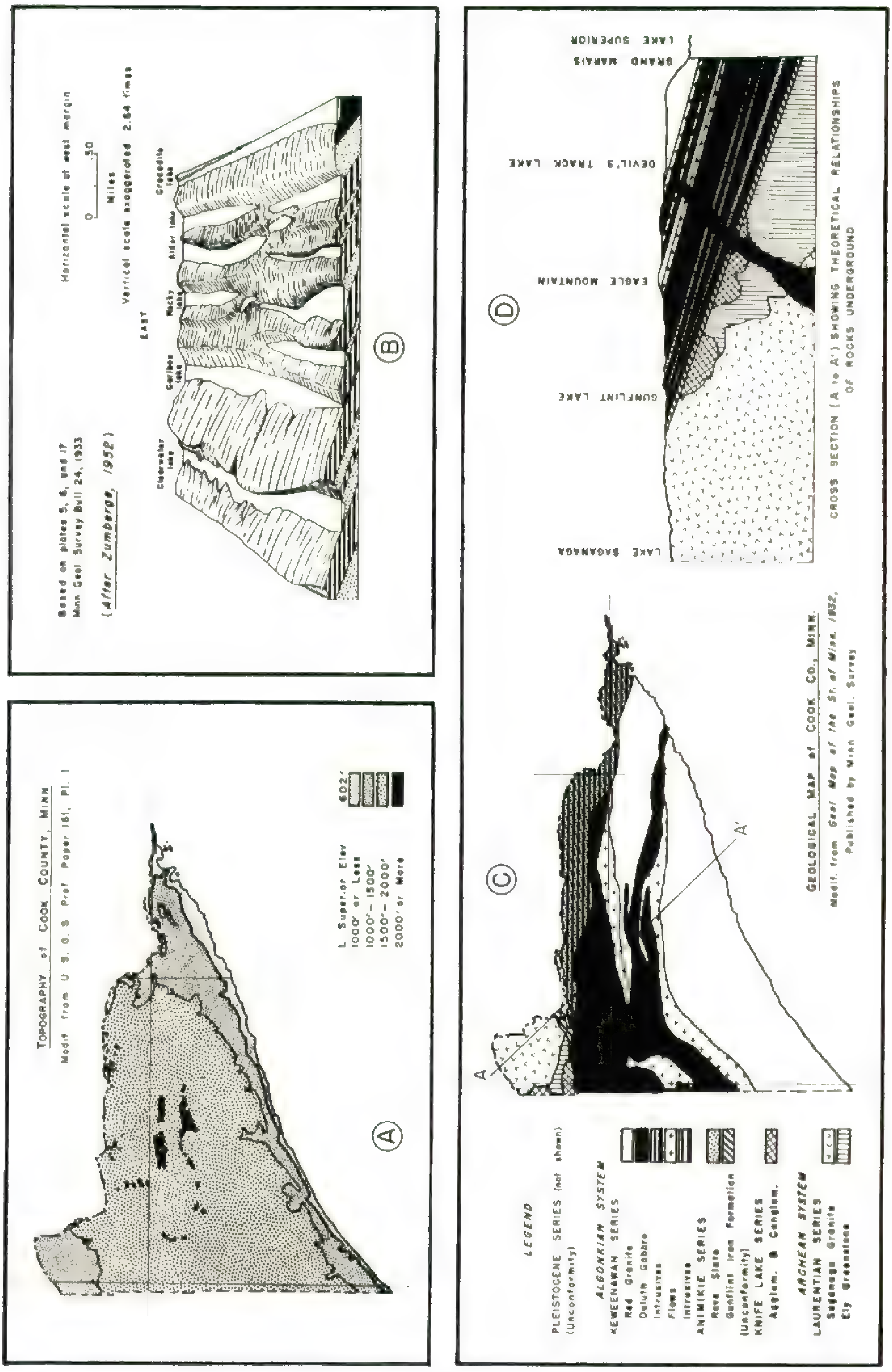

Fig. 2. Topography and Geology of Cook County. A. Topography; B. Block diagram to illustrate relation between geology and topography in the Rove Slate area; C. Geological formations of Cook County; D. Hypothetical section along line A-A′ in C.

against which to view the floristic history of Cook County. It is immaterial in the present study whether we think in terms of a single great Laurentide ice-sheet with Labradorian, Keewatin, and other centers of outward flow (Johnston, 1935; Flint, 1943), or whether we accept the long current concept of relative independence of these centers. We are specifically concerned with the ebb and flow of the Pleistocene ice within a restricted area, the Arrowhead region of Minnesota.

The scanty drift of our area seems to provide no evidence for glaciation before the Wisconsin, although Leverett (1932, p. 20) does not entirely preclude the possibility. Glacial erosion was dominant over deposition, and older glacial deposits were probably all removed during the Cary invasion. All the drift exposed on the surface is either Cary or younger in age, for it is marked by an abundance of undrained depressions, a feature not common on Tazewell or older drifts.

Cary glaciation in Cook County was accomplished by the Rainy Lobe (Elftman, 1898; Sharp, in prep.), which advanced to the south or southwest across the country. Current investigations by Wright (in prep.) suggest that the Superior Lobe was also active in Cary time, perhaps slightly later than the Rainy Lobe, and rose up from the Superior basin onto the highland rim of southern Cook County. He believes that the Superior Lobe extended west and south from the head of Lake Superior, perhaps with some Rainy Lobe ice, to reach south-central Minnesota as the Minneapolis lobe of Cooper (1935). The sketch (Fig. 3A) suggests by arrows the direction of movement of Cary ice in northeastern Minnesota.

The part of Cook County not covered subsequently by the Mankato Superior Lobe or its melt-water displays a multitude of evidences of the activity of the Cary Rainy Lobe. Ice-scoured rock outcrops with polish or striae, grooves or chatter marks, and larger features such as roches moutonées, excavated rock basins and hills, etc., are major evidences of its activity. In association with these there are great areas of a poorly consolidated brown till perhaps an average of 15 feet thick and largely (up to 90%) derived from the underlying bedrock. Glacifluvial debris, largely sand and gravel, produce in much of this area swells and swales, knobs and kettles and short ridges with a

relief of about 20 to 50 feet. These Sharp attributes to deposits accumulated upon, around and perhaps under masses of stagnant ice with debris swept onto them due to the wastage of the main ice mass of the Rainy Lobe. There are also at least sixteen clearly defined eskers 20 to 90 feet in height which add diversity to the landscape and bear testimony to glacifluvial deposition, probably in this case by glacial streams in sub-glacial tunnels. Drumlinoid ridges occur in the broad lowland along the Cross River. In the eastern part of Cook County there are brown silty clays formed in the valley of the Pigeon River; Sharp refers these sediments to proglacial Lake Pigeon which was formed by Rainy Lobe melt-water backing up against the body of the Superior Lobe which makes them early Mankato deposits.

The Two Creeks Interval is indicated in Fig. 3 because of its importance in dating events in the late Wisconsin. The Superior basin was occupied by a lake in which were deposited the red clays referred to below. The surface of Cook County during this phase was presumably free of ice, at least in large part. How long before the dated part of the Two Creeks Interval (about 11,000 years at Two Creeks, *cf.* Flint and Deevey, 1951) Cook County was ice-free is an open question, but it may well have approximated a total of 20,000 years to the present.

It appears that the Cary Rainy Lobe had largely receded from Cook County before the final advance of the Superior Lobe in Mankato time (Fig. 3B). Evidence for this conclusion is the deposition by the Superior Lobe of its characteristic red clay till over areas formerly occupied by the Rainy Lobe. It is very probable that the time interval between the two was relatively short. Cooper (1935) presents evidence from somewhat to the south of our area that blocks of late Cary ice may have been buried by Mankato outwash. The interval between these episodes has been arbitrarily set at 2500 years by Antevs (1945), but this may be much too long, judging both by Cooper's observations and by the relative magnitude of time intervals in general as determined in recent radiocarbon studies (Flint and Deevey, 1951).

With the Rainy Lobe to the north, the Mankato Superior Lobe invaded our area from the east by way of the basin of present Lake Superior (Fig. 3B). Proglacial lakes no doubt were im-

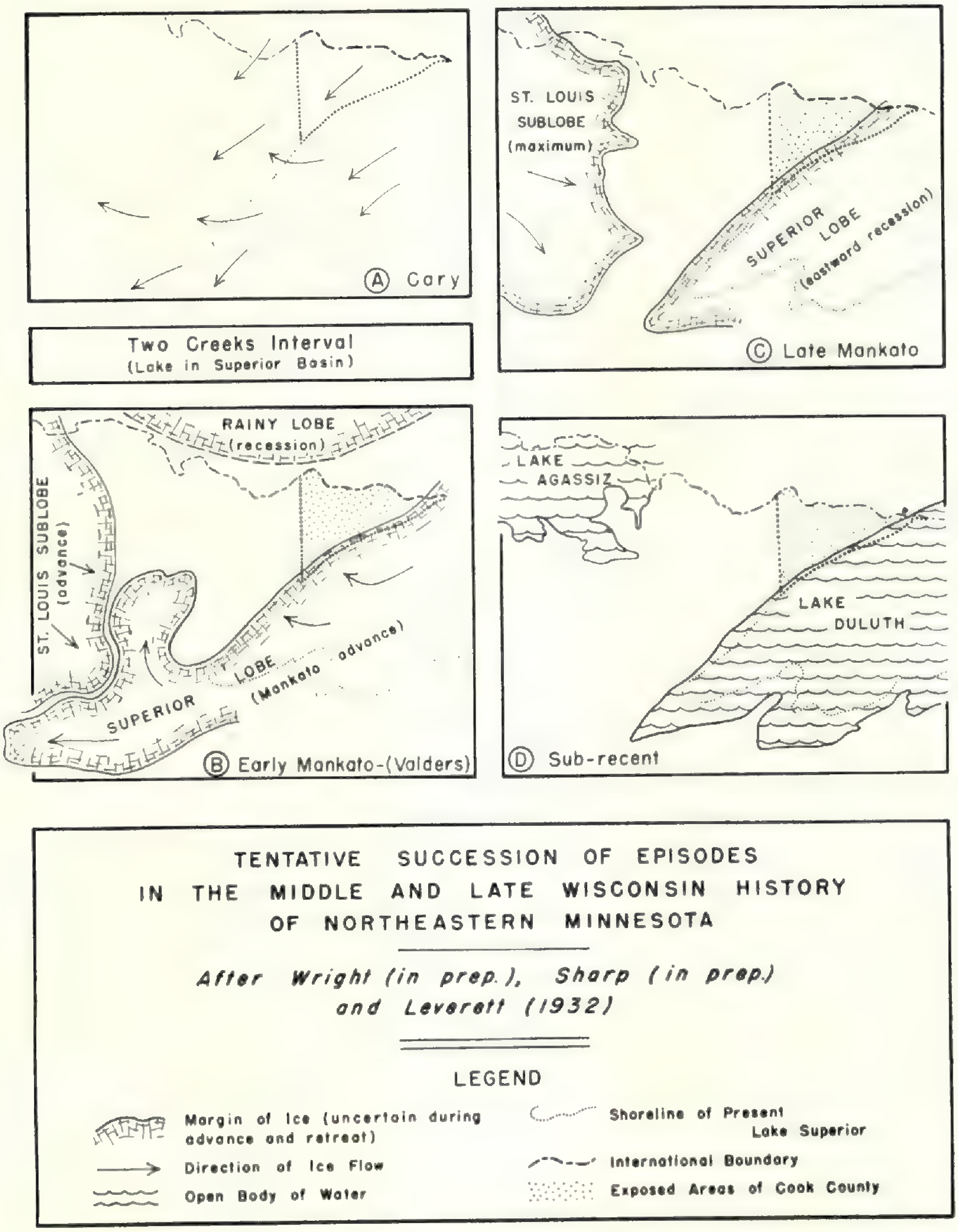

FIG. 3. Tentative Succession of Episodes in the Middle and Late Wisconsin History of northeastern Minnesota.

pounded by the advancing ice, but their red clay bottom deposits were probably ploughed up to form part of the till of the advancing ice. Those most readily recognizable in Cook County are all above the maximum elevation of the uppermost strand line of Lake Duluth (about 1270 feet in Cook County). One

group of these proglacial lakes of Mankato time occurred north of the Sawteeth Mountains in the valleys of the Poplar, Onion and Temperance Rivers; another proglacial lake occupied the Mineral Center area; and a very large one named Lake Omimi by Elftman (1898) occupied much the same area in the Pigeon River drainage as Sharp's proglacial lake of Cary time. The beds of these proglacial lakes of the Superior Lobe are characterized by their red and locally calcareous clays which overlie the brown deposits left by the Rainy Lobe.

The retreat of the Superior Lobe (Fig. 3C) left a red clay till sheet 5 to 15 feet thick roughly paralleling the present shore of Lake Superior 3 to 5.5 miles inland in Cook County, the margin of the lobe having attained an elevation of about 1450 feet near Grand Marais. The till is uncomplicated by any appreciable glacifluvial deposits, and has modified but little the topography of the region where it occurs.

A series of major glacial lakes, beginning with Lake Duluth (Fig. 3D), filled the Lake Superior basin as it was vacated by the waning Superior Lobe. Their waters reworked the red clay till of the Superior Lobe from the 1270 foot level downward and in some cases also permitted the deposition of a thin veneer of sandy gravels over the red clays. Well-defined strand lines, including wave-cut cliffs and raised gravelly beaches of the various glacial lakes are outstanding features of the shore region of present Lake Superior, although there is no local evidence for a stage recognized by Stanley (1938) as lower than the present one.

As the Superior Lobe waned eastward there was an ice invasion into northeastern Minnesota from the northwest—the St. Louis sublobe of the Des Moines Lobe (Fig. 3B & C). The recession of the Superior Lobe began before the culmination of the Des Moines. It is presumed that the maximum eastward limit of the St. Louis sublobe was reached after the retreat of the Superior Lobe had begun because of the absence, for instance, of interlobate till deposits which would indicate actual contact between the Superior Lobe and the encroaching St. Louis sublobe. Furthermore, Leverett (1932) states that morainal material produced by the Superior Lobe is overlain by drift from the St. Louis sublobe. The St. Louis sublobe achieved its maximum advance to the east in St. Louis County—still leaving

Cook County and its western neighbor, Lake County, free of ice (Fig. 3C). Upon the retreat of the parent Des Moines Lobe, Lake Agassiz extended into the northwestern part of the Arrowhead region (Fig. 3D). From that time on the Arrowhead has been free of continental ice.

c. Soils. The general character of the soils of the county has been determined to a large extent by its glacial history and its bedrock geology. These have been described in the two preceding sections.

Two major soil associations are recognized in the county (McMiller, 1947); one is the Ontonagon, the other the Milaca-Cloquet soils group.

The Ontonagon is the local representative of the *Brown-Forest* soil group and occupies the portions of the county formerly covered by Lake Duluth (Sharp, in prep.). It is a gray to light grayish brown clay loam derived from the red lake clays and the Superior red clay of the original parent material. There is a relatively high content of bases which seems to retard the process of podzolization. By implication, then, it is conceded to be an immature soil, a view in keeping with its known history in Cook County.

The Milaca-Cloquet is the local representative of the *Brown-Podzolic* soil group and occupies that portion of the county in which the present surface formations are the result of the activity of the Rainy Lobe. It is derived from the brown sandy tills. Nygard, McMiller and Hole (1952) in their discussion of brown-podzolic soils comment on the occasional occurrence of "double profiles" (a repetition of the profile), which Wright (*in litt.* Oct. 5, 1951) has suggested is a record of climatic and vegetational change.

Little, if any, information on the very extensive peat soils is available.

In contrast to these widely distributed Cook County soils, there are "soils" of very limited occurrence today which are of marked phytogeographical importance. These occur at the upper margins of the talus slopes and on ledges of the high cliffs of the Rove slate area, as well as on recently exposed surfaces of some phases of the diabase trap which weather quickly. All of these soils have in common the characteristic of extreme newness, a gravelly to fine texture, and of being subject

to disturbance due to freezing and thawing. Quite naturally they partake of the character of the parent rock. When this is slate or a basic phase of the diabase the raw gravelly soil, if moist, often forms an excellent substratum for the growth of the rarities of the region. The absence of root competition or shading due to forest trees in the limited areas where these soils are formed further favors these plants.

On the other hand the original glacial soils of the county, even when they were somewhat calcareous, are becoming progressively more acid as the humus produced under the widely dispersed coniferous forest continues to accumulate. Added to this is the leaching of the calcium carbonate and the decomposition of calcium-bearing silicates followed by removal in solution of their calcium. This is very markedly the case in portions of the county in which the underlying rock is fundamentally acid, such as the Saganaga granites. Thus the extent of the substratum suitable for the growth of calcicoles is becoming progressively more limited. An example of this is to be found on the talus slopes in the Rove slate area (Plate 1190A). The talus slopes below the smaller cliffs have by now become stabilized and are covered by the encroaching and ubiquitous coniferous forest. It is only the tallest cliffs whose taluses have not yet been stabilized, and which therefore have not yet been invaded by the forest. Here are still to be found the basic gravels in a narrow strip along the top of the taluses and on ledges where the rarities survive.

On the shore of Lake Superior the analogue of the localized gravels of the back country is to be found in the new rock surfaces which are being exposed as the beach line drops with the passage of time (Plate 1191). On the ledges of the exposed shore cliffs and in the cracks and crevices of the rock points contemporary weathering is producing mantle rock derived directly from the underlying bedrock. The forest has often not yet occupied these areas, so that again rarities have the opportunity of surviving in these limited and precarious ecological niches.

3. Climate

The contemporary climate of Cook County has been summarized by Pursell (*in* Leverett and Sardeson, 1917) and more recently by Hovde (1941). The data presented below are

largely taken from the latter. Observations in the county are primarily limited to the station at Grand Marais.

The climate of the county may be characterized as cool temperate. Along the shores of Lake Superior it is strongly conditioned by this vast cold mass of water. According to Pursell the mean annual temperature of the county varies from 36° to 38° F. in contrast to an average of about 45° F. in the hot southeastern part of the state.

The mean temperature in January ranges from 8° F. along the Lake Superior shore to 14° F. inland, and has reached a minimum of − 34° F. during the winter; in July it ranges from 60° F. at the east to 62° F. in the west, and a summer maximum of 100° F. has been recorded.

The frost-free season is approximately 120 days in length as contrasted with one of 150–160 days in the southernmost part of the state. The last killing frost in the spring occurs about May 25 in the southern part of the county and is about 5 days later in the northern part of the county; the first in the fall is about September 15 in the southern part of the county and about 10 days later inland from Lake Superior.

Annual precipitation is between 24.7 and 31.5 inches, of which about 18 inches is during the warmer months. Information on the depth of winter snow, so important in its bearing on depth of soil frost and plant cover, seems to be unavailable.

There is a gradient in summer climate even within the rather limited area of the county. The region along the immediate shore of Lake Superior is colder and often foggy in summer, while the "back country" on the plateau extending to the Border Lakes is warmer and the skies clearer.

Information concerning microclimates is completely lacking although it would be of great interest to have this, especially because of its possible bearing on the localized occurrences of the rarities. Perhaps the most significant testimony, short of actual instrumental observations, is that the microclimates in restricted ecological niches permit the growth and reproduction of a limited number of species with subarctic or other geographic affinities.

The fluctuations in sub-recent climates are of tremendous significance in view of the diverse floristic components of the

county. In contrast to the earlier experience of the junior author (Abbe, 1936) it is no longer necessary to plead the case for a "xerothermic" period or a "climatic optimum" or thermal maximum (Flint and Deevey, 1951) during post-glacial time. The evidence for considerable variation in post-glacial climates is clear both for Europe and America, and has been admirably summarized and evaluated by Deevey (1949). Today the major problems are, (1) the probable sequence of climates in any particular locality (*cf.* Deevey, 1949, Table 7) and, (2) the probable duration of each. The former is far more significant phytogeographically than the latter, especially as it concerns "late glacial" time. Certainly the duration of the climatic phases should not be dismissed summarily from consideration, but in view of the speed with which species are dispersed, especially if a great reservoir of individuals is immediately adjacent to a region about to be invaded, time seems to become limiting only under exceptional circumstances.

Flint and Deevey (1951) summarize radiocarbon data which permit the conclusion that the Mankato maximum in the Two Creeks (Wisc.) area occurred about 11,000 years ago. This provides an approximate base for determining the date of the final opening up of the Arrowhead region for permanent plant occupation; the departure of ice during the Cary would be our critical date—it would antedate 11,000 years appreciably.

The first climatic phase in our glaciated areas which is significant to the phytogeographer is that which existed at or near the ice margin. Deevey, by 1949, was able to cite only one case, and that for Maine, in which pollen analytical studies provide useful evidence concerning the plants of the periglacial zone. Apparently in Maine "tundra" species existed near the ice margin. Supporting evidence from the middle west is provided by Sharp's (1942) report of involution layers in glacifluvial formations in the upper Illinois valley. Their presence leads Sharp to conclude that periglacial or arctic conditions existed at a distance of 30 to 50 miles beyond the border of late Cary ice. Certainly, as Deevey (1949) explains, more evidence from North America is badly needed; but by analogy with the wealth of information available in Europe it may be expected that subsequent research will demonstrate the transitory presence of

pioneer, cold tolerant, short season species in areas that were immediately adjacent to the ice. Their presence would not necessarily constitute evidence for the existence of a tundra climax at such localities.

Following the pioneers in depositional sequence are the plants so well known on palynological grounds from the upper Middle West (Minn. to Ind.) and summarized by Deevey (1949, Table 7) as follows. Zone A, characterized by spruce and fir, which are taken to indicate a cool climate; Zone B, with pine indicating a warmer, dry climate; Zone C1, with pine, oak and elm in Minnesota and Wisconsin followed by Zone C2, with pine declining in Minnesota and Wisconsin indicating a warm, dry climate; Zone C3, with spruce returning at some localities in Wisconsin and Minnesota suggesting a trend toward a cooler, moister climate.

Too specific an application in Cook County of the above generalizations is unwarranted, the more so because no pollen analytical data have been obtained there. It seems reasonable to assume that as the Cary ice disappeared from the Arrowhead, something over 11,000 years ago, there was a periglacial climate which could be tolerated by pioneer species capable of quickly invading the new terrain. Many of these were arctic and tundra species whose descendants are still present in the area. This pioneer conglomerate—one hardly dares call it a well-defined community—was probably promptly infiltrated by willows, aspens, balsam poplar and northern conifer forest species as quickly as they could migrate in from adjacent seed sources. No general moderation of climate would be necessary for such a succession of events, although at least the microclimates must have changed. However the incursion of hardwoods and the subsequent return of the conifers is surely to be related to the thermal maximum of 3,000 (to perhaps 6,000) years ago (Flint and Deevey, 1951).

A guess as to the magnitude of the climatic change from the thermal maximum to the present may be based on a comparison of Cook County with the present "Big Woods" in the south central part of the state (*cf.* Braun, 1950). That this comparison is relevant is supported by the presence today of relic stands of sugar maple in Cook County. In the "Big Woods" the growing season is 140 to 150 days, as contrasted with about 120 days in Cook County; the mean July temperature in the "Big Woods"

area is 70–72° F., while it is about 60–62° F. in Cook County (Hovde, 1941). Thus during the thermal maximum, perhaps 3,000 years ago, the growing season in Cook County might well have been 20 to 30 days longer and the mean July temperature 10° F. higher. Such conjectures must be looked upon with marked skepticism until further evidence is brought to bear upon them. Biological evidence would appear to be most productive of results here, but care should be taken to avoid organisms with very brief life spans so that the possibility of very rapid selection is excluded. From this point of view long-lived trees like the sugar maple seem, superficially at least, to be very favorable for such a purpose.

4. Summary of Environmental Conditions in Cook County

The county is in the western part of the Laurentian Upland and possesses the greatest range in elevations in the state—from 602 ft. above sea level along the Lake Superior shore to 2230 ft. for the Misquah Hills inland. There is an abrupt rise from the shores of the lake to the Sawteeth Mountains at the southern edge of the rolling upland, which itself averages about 1500 ft. above the sea level.

Bedrock control of topography is marked. The northwestern part of the county, beyond the height of land is primarily occupied by Archean rocks, the Saganaga granites and Ely greenstone. Here the drainage is northward into the Hudson Bay system, and the lakes are more or less rounded in outline. The rest of the northern part of the county is the area of the Gunflint iron formation and the phytogeographically important Rove slates, both being older phases of the Algonkian system. Keweenawan flows and intrusives extend into this area, being responsible along with the interbedded slates for the development of a pronounced cuesta type of topography. East-west valleys are strongly developed, and the deep lakes in them are set off on their southern sides by large, north-facing cliffs, many of which have active talus slopes. The rest of the county is occupied by more recent phases of the Algonkian, red granite, Duluth gabbro, and extensive developments of Keweenawan intrusives and flows. Topographically the region is rolling, its lakes tending to follow the grain of the country, but less limited

in form than are those of the Rove slate area. In general the rivers flow southward, forming miniature canyons in their final descent to Lake Superior.

At least 25% of the surface of the county is occupied by lakes and muskegs, the balance being glacial materials except for extensive exposures of ice-scoured and bare rock. The glacial material in the region not subsequently covered by the Mankato Superior Lobe is largely a poorly consolidated brown till reflecting the character of the underlying bedrock; glacifluvial debris and other localized manifestations of the activity of the Cary Rainy Lobe are also present. In the region covered by the Mankato Superior Lobe and the bodies of water impounded by it, the surface material is a characteristic red clay till and red lake clay.

The general sequence of events from the maximum of the Rainy Lobe to the present seems fairly clear. At its maximum the Cary Rainy Lobe completely covered Cook County. The Rainy Lobe retreated northward across the Arrowhead and the Superior basin was filled by a lake—this was the Two Creeks Interval more or less reliably dated on C_{14} evidence as about 11,000 years ago. This was followed by an invasion of the Superior basin by the Mankato Superior Lobe; this may have been a reinvasion. Contemporaneously there may have been a slight southward readvance of the Rainy Lobe, but not far enough south to meet the Superior Lobe. There also began an advance from the northwest—the St. Louis sublobe. The Superior Lobe then began its final eastward retreat, and the Rainy Lobe its northward retreat, while the St. Louis sublobe attained its maximum southeastward extension. The continued eastward waning of the Superior Lobe in the Superior basin dammed the meltwaters there to produce a series of glacial lakes, one of which was Lake Duluth; similarly the parent body of the Rainy Lobe of the St. Louis sublobe had retreated northward into the Hudson Bay basin and acted as a dam which impounded Lake Agassiz. The final disappearance of ice in the Superior and Hudson Bay basins allowed Lake Agassiz and Lake Duluth to shrink to the limits of the lesser contemporary bodies of water now in their respective basins. Thus at least from late Cary time something more than 11,000 years ago when the Rainy Lobe retreated north across Cook County, this area has been

available for plant immigration and occupation. The direction of migration was probably northeastward, westward, and southwestward from areas of vegetation not destroyed by Cary and Mankato ice.

The mineral soils of the county strongly reflect its bedrock geology and its glacial history. The region formerly occupied by Lake Duluth has clay loams belonging to the *Brown-Forest* group, while the rest of the county has soils belonging to the *Brown-Podzolic* group. Double profiles occur in the latter, which may indicate broad climatic fluctuations in the area. Very limited "soils," or more properly, finely comminuted rock material of contemporary origin, occur on the exposed rocks and cliff bases in the county; these are of great phytogeographic interest because they harbor certain of the rarities of the county. Whatever the origin of the soil there is a gradual tendency toward leaching out of the bases, so that habitats suitable for calcicoles are becoming progressively more limited except for the current production of fine gravel due to weathering of exposed rock.

The contemporary climate is cool temperate; the growing season is relatively short (about 120 days); precipitation is abundant both in summer and winter, with a plentiful snow cover in the winter. Judging by the presence of relic stands of sugar maple, the climate was probably somewhat milder during the thermal maximum perhaps 3 to 6,000 years ago. The extent of this "mildness" may be judged from the greater length of the growing season by 20 to 30 days, and a mean July temperature some 10° F. warmer in the "Big Woods" part of the state where the sugar maple thrives today. This thermal maximum marked the culmination of a period of climatic amelioration which started with a frigid periglacial tundra climate over 11,000 years ago.

5. General Features of the Flora and Vegetation

The immediate impression that is given by the plant cover of Cook County is one of a boreal wilderness uncomplicated by extensive agriculture, and but slightly modified by the tourist trade along the roads. Nevertheless, fires following heavy and destructive lumbering shortly after the turn of the century

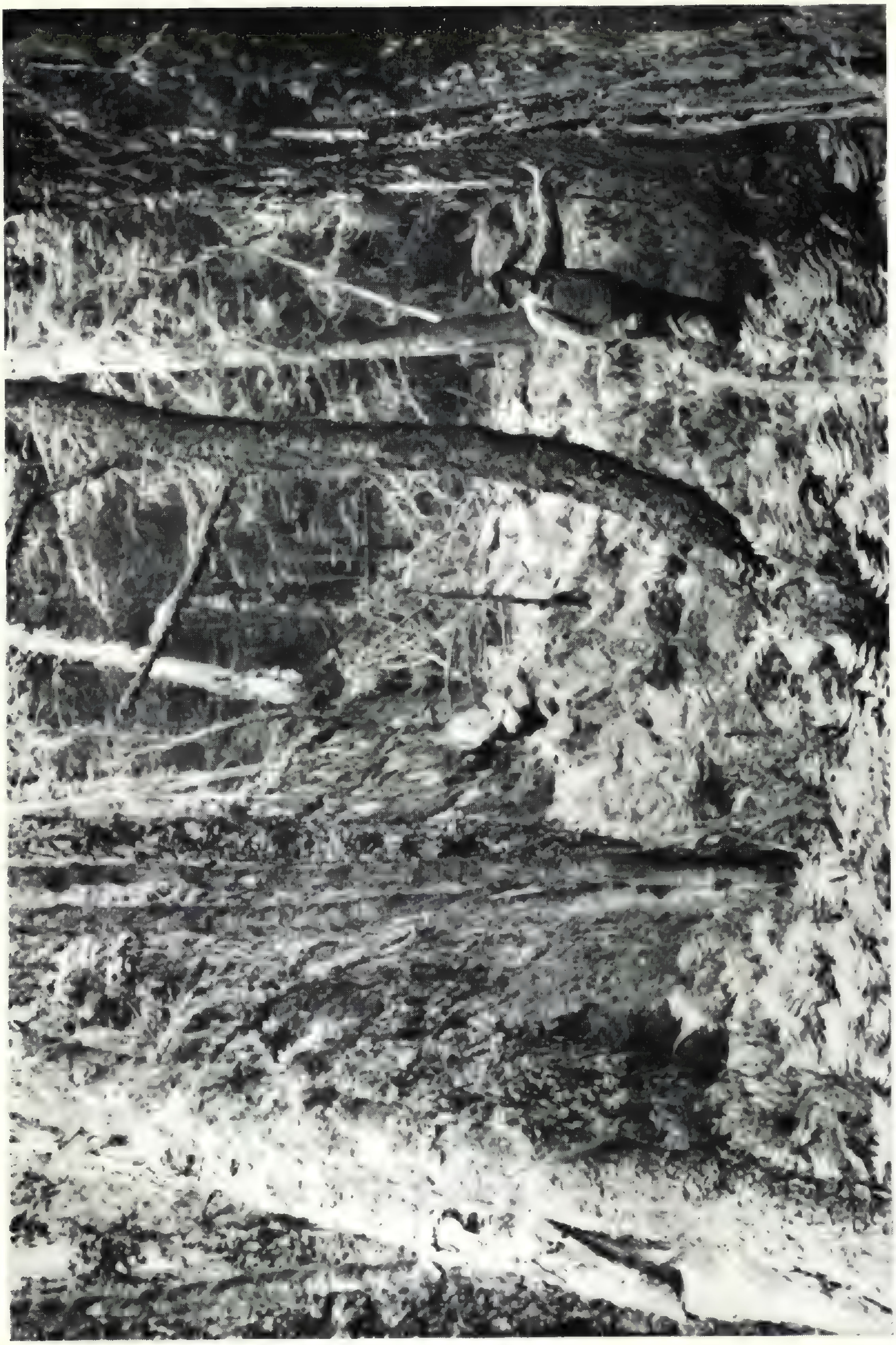

PLATE 1192. Center of Lucille Island (Susie Islands); opening in dense spruce forest, Dr. F. K. Butters in foreground, Mrs. L. B. Abbe in middle background.

(Smith and Moyle, 1944) added to the effects of earlier fires set by mineral prospectors (Winchell, 1879; Hall, 1880) led to an extensive development of "brush"; only recently has much of this returned to thrifty second-growth woods. While these man-made catastrophes have left their imprint on great areas, there still remain limited patches of nearly virgin forest in the more inaccessible parts of the county.

A detailed ecological analysis of the county still remains to be made. Fortunately Cooper's (1913) classic account of the development of the climax forest of near-by Isle Royale is available. One major feature of the flora in Cook County which is not treated in Cooper's study is what may be termed the talus slope succession and another is the sugarbush, both of which are of great phytogeographic significance. Otherwise the application of Cooper's observations becomes a problem in the redistribution of emphasis; especially is this the case with the secondary successions which on Isle Royale are burn successions of limited extent, but in Cook County constitute a very widespread phenomenon.

Primary successions:—Cooper finds these falling into two series on Isle Royale, one xerarch, the other hydrarch. His xerarch successions along the shore are in a large part initiated on the well-drained rock surfaces, in the crevices of these shore rocks, and in the rock pools. The pioneers are crustose lichens and mosses on the rock surfaces, and *Potentilla tridentata, Trisetum spicatum, Aster ptarmicoides, Campanula rotundifolia*, etc., in the rock crevices, and *Scirpus cespitosus, Potentilla tridentata, Vaccinium angustifolium*, and mosses by the rock pools. Each series is followed by a sequence of other species—other lichens in the case of the rock surfaces, shrubs such as *Vaccinium uliginosum, V. angustifolium, Juniperus horizontalis, J. communis* var. *depressa, Arctostaphylos Uva-ursi* in the crevices, and *Vaccinium uliginosum, V. angustifolium, Andromeda glaucophylla* and *Calamagrostis canadensis* by the rock pools. These subsuccessions ultimately coalesce into the heath mat in the formation of which the crevice species are the active agents. The mesophytic climax forest (*Abies balsamea, Betula papyrifera sens. lat.*, and *Picea glauca*) either invades the heath mat directly, or the xerophytic forest (*Pinus Banksiana* and *Picea mariana*) acts as

an intermediary to the establishment of the mesophytic climax. The xerarch successions may also be initiated on the beaches which are of limited extent and but sparsely occupied by such species as *Equisetum arvense*, *Epilobium angustifolium*, *Deschampsia caespitosa*, etc., which are followed by such shrubs as *Alnus crispa*, *Cornus stolonifera* and *Salix* spp., which finally and often abruptly give way to the mesophytic climax forest.

Cooper's rock shore and beach successions are described in great detail and apply very aptly to similar Cook County conditions as these now exist along the shore of Lake Superior. Only in one detail does the junior author find his observations subject to criticism—this is in Cooper's brief discussion of a "gull" island with its curious admixture of shore and forest species. Such islands also occur on the North Shore of Lake Superior, and the junior author has noted them on the North Shore of the Gulf of St. Lawrence, on the coast of Labrador, and on Hudson Bay. These "grassy" islands are sporadic in occurrence, other islands of similar size failing to be occupied by waterfowl and then exhibiting floristic conditions which may be considered essentially normal. I cannot therefore agree with the suggestion hazarded by Cooper that the "grassy" islands may have the kind of vegetation which first occupied the islands of Lake Superior and its predecessors as these islands emerged and became available for plant occupation. I am willing to recognize the probability that gulls and other waterfowl occupied occasional ones of the islands which slowly emerged, and that the floras of these islands would resemble the one described by Cooper, but I am of the opinion that the floras of islands equally small and not so occupied would follow Cooper's rock shore and beach succession.

In addition to the xerarch successions, Cooper describes two types of hydrarch succession. One is the bog succession which is initiated by aquatics (*Ranunculus trichophyllus*, *Potamogeton perfoliatus*, *Carex* spp.) followed by a sedge mat which may be followed either by bog shrubs (*Chamaedaphne calyculata*, *Andromeda glaucophylla*, *Alnus rugosa* var. *americana*) giving way directly to bog forest (*Larix laricina*, *Thuja occidentalis*) or first passing through a *Ledum groenlandicum-Sphagnum* phase before a bog forest of *Larix laricina* and *Picea mariana* becomes established. In either event the bog forest is ultimately succeeded

by the mesophytic climax forest. Again Cooper's observations are eminently applicable to the great areas of bog in Cook County, whether on the upland or within the shore area.

The second of Cooper's hydrarch successions is that of the delta swamp succession in which an initial phase of aquatics is followed by the sedge mat as in the bog succession. At this point there may be a shift to the bog shrub association which proceeds through the bog forest to the climax forest. However he observes that in general the sedge mat is invaded by grasses, notably *Calamagrostis canadensis*, followed by shrubs (*Myrica Gale*, *Alnus rugosa* var. *americana*), and then by the swamp forest (*Thuja occidentalis*, *Larix laricina*, *Fraxinus nigra*) which again culminates in the climax forest. In Cook County the areas suitable to the development of this succession are relatively limited as compared with the bog succession, but are nevertheless fairly numerous both on the upland and along the shore of Lake Superior.

Secondary successions:—On Isle Royale Cooper describes two burn successions each of which follows fire in the climax forest. In one the coniferous element of the climax is destroyed but the humus is little harmed. The surviving birches sprout from the stump, *Epilobium angustifolium*, *Anaphalis margaritacea*, seedling birches and aspens come in, and finally the conifers return, re-establishing the climax forest. The second type of burn succession follows a more drastic type of fire in which the humus is destroyed and the bare rock is exposed. The return of the climax follows essentially the rock shore succession. In Cook County the picture is undoubtedly far more complex than this in view of the burning and re-burning which has occurred in various stages of the variety of possible successions. Vast areas of the county fall in this category and await detailed study.

Another type of secondary succession which the situation on Isle Royale presumably does not cover is initiated by the man-made destruction of the original plant cover along roadsides, barrow pits, clearings about buildings, and the naturally occurring cut-banks along streams and rivers, and the local effects of major rock falls from cliff faces onto the subjacent talus slopes already in the various stages of the talus succession.

One of the most significant associations on Isle Royale, that dominated by *Acer saccharum*, Cooper could not study, but

recognizes the fact that "southward it is probably able to supersede the conifers and birch." The importance of this association in Cook County cannot be overlooked, and naturally the question arises as to why it has not "superseded" the conifers there also.

The three major types of forest which the writers have noted in Cook County are:—*a.* the Jack-pine barrens of the northwestern part of the county; *b.* the mixed conifer-hardwood forest occupying most of the upland and slopes along the shores of Lake Superior; and *c.* the localized groves of "sugar bush" occurring along the southern shoulder of the upland.

a. Jack-pine barrens.—As indicated by their name, these are characterized by *Pinus Banksiana.* They occur in the northwestern part of the county where the underlying rock consists predominantly of the acid Archean granites and where the drift mantle is itself acid like the underlying granite. Rapid drainage of the soil and its low nutrient supplying power also are major factors. Undergrowth is characteristically sparse, some of its species being *Vaccinium angustifolium, Rosa acicularis* (*sens. lat.*), *Chimaphila umbellata* var. *cisatlantica,* etc.

Extensive *Betula pumila-Ledum-Chamaedaphne* bogs occur in the shallow rock basins of this part of the county. Along with *Betula pumila* var. *glandulifera, Ledum groenlandicum,* and *Chamaedaphne calyculata* are their familiar companions in this type of bog, such as *Andromeda glaucophylla, Carex tenuiflora, Salix pedicellaris* var. *hypoglauca, Solidago uliginosa, Sphagnum* spp., *Vaccinium Oxycoccos,* etc., etc. Essentially similar bogs occur here and there throughout the mixed conifer-hardwood forest area, although, oddly enough, *Betula pumila* var. *glandulifera* is characteristically absent from them.

The flora of that portion of the county which is underlain by Archean granites is notable for the small number of species present and its corresponding lack of floristic interest. Nearly as poor floristically as the Jack-pine barrens proper is the west central part of the county as exemplified by the region around Winchell Lake. Here the red rock differentiate of the Duluth gabbro is the underlying rock. It breaks up into large blocks which accumulate below the cliff faces and weather but slowly so that little soil is formed from this massive rock type. The cliffs are abundant and high, but extremely limited in number of

species of vascular plants. This proved to be something of a disappointment to the writers because this is the highest part of the Lake Superior-Hudson Bay watershed and, if "nunataks" in the Fernaldian sense could have been expected, this is where they should have been. The plants present gave no assistance in justifying such a hypothesis here. Nor did the abundant evidence of heavy and recent glaciation hold out hope from the geological point of view.

b. Mixed conifer-hardwood forest.—The mixed conifer-hardwood forest in its multifarious aspects covers the greater part of the remainder of Cook County. The underlying rocks in this region of richer vegetation are the various intrusives and flows of the Keweenawan series (often less acid than the Archean granites) and sedimentaries of the Animikie series, notably the Rove slates. The drift mantle is more varied, often more clayey and the exposed intrusives tend to weather more rapidly than do the rock surfaces of the Winchell Lake and Archean areas.

Tree species which are characteristic of the mixed conifer-hardwood forest are *Abies balsamea, Pinus Banksiana, Populus tremuloides, Betula papyrifera* (*sens. lat.*), *Picea glauca*, and occasionally, *Pinus Strobus* and *P. resinosa.* Different phases of this forest have different proportions of these tree species. Shrubs and small trees often present with these are *Acer spicatum, Amelanchier* spp., *Corylus cornuta, Lonicera canadensis, Prunus pensylvanica, Rubus idaeus* var. *strigosus, R. parviflorus* (*sens. lat.*), *Salix* spp., etc. Ground cover includes *Antennaria* spp., *Aralia nudicaulis, Aster ciliolatus, A. macrophyllus, Clintonia borealis, Cornus canadensis, Epilobium angustifolium, Habenaria obtusata, Lathyrus ochroleucus, Mertensia paniculata, Oryzopsis pungens, Poa palustris, Pteridium aquilinum* var. *latiusculum, Schizachne purpurascens, Solidago* spp., *Trientalis borealis,* etc., etc.

Occasional groves of *Pinus Strobus* occur here and there in the mixed forest, and in these groves occur as associates *Abies balsamea, Acer spicatum, Anemone quinquefolia, Aster macrophyllus, Betula cordifolia, Clintonia borealis, Cornus canadensis, Corylus cornuta, Lycopodium annotinum, L. obscurum* var. *dendroideum, Maianthemum canadense, Prunus pensylvanica, Pteridium aquilinum* var. *latiusculum, Pyrus americana,* and *Viola*

renifolia. Similarly *Pinus resinosa* occasionally forms groves on lighter well-drained soils which are often of a morainic character.

There is also a Jack-pine phase of the mixed forest in which *Abies balsamea* is sometimes the understory, along with occasional individuals of *Picea mariana* and *Betula papyrifera.* Present with these are *Amelanchier humilis, Apocynum androsaemifolium, Aralia nudicaulis, Aster macrophyllus, Chimaphila umbellata* var. *cisatlantica, Clintonia borealis, Cornus canadensis, Corylus cornuta, Danthonia spicata* var. *pinetorum, Fragaria virginiana, Goodyera repens, Halenia deflexa, Linnaea borealis* var. *americana, Lonicera canadensis, Melampyrum lineare, Moneses uniflora, Pteridium aquilinum* var. *latiusculum, Pyrola secunda, Spiranthes gracilis, Streptopus roseus* var. *longipes, Vaccinium myrtilloides,* etc.

Thuja occidentalis and *Picea mariana* often predominate in less well drained places in the mixed hardwood forest. Associated with them are *Abies balsamea, Alnus rugosa* var. *americana, Aralia nudicaulis, Athyrium angustum* var. *rubellum, Betula cordifolia, Carex disperma, Clintonia borealis, Coptis groenlandica, Cornus canadensis, Dryopteris disjuncta, D. spinulosa, Gaultheria hispidula, Habenaria obtusata, Linnaea borealis* var. *americana, Lycopodium annotinum, Maianthemum canadense, Mitella nuda, Moneses uniflora, Osmunda Claytoniana, Oxalis montana, Pyrus americana, P. decora, Ribes* spp., *Rubus pubescens, Trientalis americana, Viola palustris,* etc.

Rarely, limited groves of *Fraxinus nigra* occur in protected moist depressions in the mixed forest and with it occur, as associates, *Ranunculus septentrionalis, Galium trifidum* and others.

The dry hilltops and exposed dry rock ledges and drier cut banks may or may not have tree cover, but are likely to have present such herbaceous species as *Arabis divaricarpa, Campanula rotundifolia, Carex xerantica, Chenopodium hybridum* var. *gigantospermum, Convolvulus spithamaeus, Corydalis sempervirens, Danthonia spicata* var. *pinetorum, Equisetum hiemale* var. *affine, Geranium Bicknellii, Heuchera Richardsonii, Lactuca ludoviciana, Oryzopsis pungens, Poa compressa, P. interior, Potentilla tridentata, Selaginella rupestris,* etc.

Highly localized open gravel pits have been created in the course of the limited road-building program of the county.

Here appear among other species *Aster macrophyllus, Bidens vulgata* var. *puberula, Carex Crawfordii, C. Houghtoniana, Gnaphalium Macounii, Juncus brevicaudatus, J. bufonius, J. tenuis* f. *Williamsii, Poa palustris, Typha latifolia*, etc., the species present depending on whether the gravel pits are dry or wet.

The weed flora is extensive especially along roadsides, although occasionally an introduced species will gain a foothold near one of the tourist lodges. The more certain snow cover in the winter, along with the cool summers, may well explain the success of many north European weeds in Cook County, while in contrast the same species do but poorly (except in gardens) farther south in the state. Very obvious examples of this are *Chrysanthemum Leucanthemum, Ranunculus acris* and *Polygonum Hydropiper*. Other weed species are *Silene Armeria, Carum Carvi*, and *Viola tricolor*.

The mixed forest is freely interspersed with streams, rivers, and occasional back waters and flood plains, lakes, swamps, and bogs. The swamp woods are often dense and in them predominate *Larix laricina, Picea mariana* and *Thuja occidentalis*, with a very limited undergrowth of *Gaultheria hispidula, Equisetum scirpoides, Carex* spp., *Oxalis montana*, etc. Or *Alnus rugosa* var. *americana* dominates in some swamps, having associated with it *Dryopteris cristata, Aster puniceus, Glyceria canadensis* and *G. striata*, etc. Along stream banks occur as associates the familiar woody species *Alnus rugosa* var. *americana, Myrica Gale, Cornus stolonifera*, species of *Salix*, and *Fraxinus nigra*, with an undergrowth of *Thalictrum dasycarpum, Juncus effusus* var. *Pylaei* and *Scirpus pedicellatus*.

In the sphagnum bogs there is often an occasional *Larix laricina*, along with *Carex canescens* var. *subloliacea, C. cephalantha, C. Houghtoniana, C. paupercula* var. *pallens, C. vaginata, Chamaedaphne calyculata, Dryopteris spinulosa* var. *americana, Glyceria striata* var. *stricta, Ledum groenlandicum, Monotropa uniflora, Osmunda cinnamomea, Potentilla palustris, Utricularia intermedia, U. minor*, etc. Along lake shores there frequently occur *Scutellaria epilobiifolia, Megalodonta Beckii, Galium trifidum, Glyceria borealis, Spiraea alba, Lysimachia terrestris*, etc.

In the back waters of streams or in shallow slow streams are to be found *Calla palustris, Callitriche palustris, Carex rostrata*

var. *utriculata, Eleocharis palustris* var. *major, Glyceria Fernaldii, Hippuris vulgaris* f. *fluviatilis, Isoëtes muricata, Potamogeton Berchtoldi, Sagittaria latifolia* f. *gracilis, Scirpus pedicellatus,* etc. Smith and Moyle (1944) characterize the water of the streams of the North Shore as comparatively soft, the plants being therefore members of the soft water flora or else widely tolerant and ubiquitous. They point out that hard-water species such as water cress are absent.

In the lakes there are *Elodea canadensis, Isoëtes macrospora, Lobelia Dortmanna, Myriophyllum alterniflorum* var. *americanum, Najas flexilis, Nuphar rubrodiscum, Potamogeton epihydrus* var. *Nuttallii, P. gramineus, P. praelongus, P. Spirillus, Sagittaria cuneata, Sparganium angustifolium,* and rarely, *Subularia aquatica.*

c. The sugar-bush.—The existence of localized sugar-bush along the north shore of Lake Superior has been an object of special comment at least since Dr. John Bigsby (1850, vol. 2, pp. 202–3) in 1823 observed "a ridge of sugar maple trees many miles long" which extended westward from Michipicoten Bay "with breaks" to St. Mary's River at a "distance of ten, fifteen, twenty miles from the lake." He goes on to say "There is another, which stretches from the Perdrix [Pigeon] Falls, near the Grand Portage, to the Fond du Lac. Those extensive groves of sugar-maple are highly prized by the Indians." No doubt a search of the early literature, manuscript diaries, etc. would reveal mention by those who came before him of the use of the products of the sugar maple by the Indians of the region. It would be surprising if so highly esteemed a product as maple sugar had not entered into the ventures of the old fur traders.

Today there are still groves of sugar maple along this shoulder of the upland in Cook County. In addition to *Acer saccharum,* there are present as highly characteristic associates *Maianthemum canadense* var. *interius* (replaced in the surrounding country by *M. canadense, sens. str.*), *Smilacina racemosa, Polygonatum biflorum, Arisaema atrorubens, Osmorhiza Claytoni, Betula lutea,* etc.

The survival of so familiar an association as the sugar-bush well north of its optimum region of development in the state may be attributed to the probability that there is a longer frost-free

period at the edge of the upland, where air drainage is more active than elsewhere in the county. *Acer saccharum* is notably susceptible to frost, especially in the spring, and would presumably not thrive if late spring frosts were at all frequent along the edge of the upland. In a preceding section on Climate it has been pointed out that, if these relic stands represent a former northeastward extension of the "Big Woods," the climate in the county during the thermal maximum can be roughly characterized. Judging by the present climate in the Big Woods region of south central Minnesota, there would have been a growing season some 20 days longer, with the last spring frosts occurring earlier, but with little change in the date of the less critical fall frosts; and mid-summer temperatures (July) averaging perhaps 10° F. higher than they now do. Whether the soils of the sugar-bush in Cook County reflect the climatic history still remains to be determined.

6. The Localized Habitats and Their Plants

There is a poorly defined line between the groups of plants mentioned in the preceding section and in the present. Thus the sugar-bush, the roadside weeds, and the plants growing in the recent gravel pits might appropriately have been considered here.

It is the puzzling phytogeographic picture presented by the rarer plants of the localized habitats mentioned below which tends to hold them together. Some simple system of assigning these species, many disjunct in their distribution, to particular phytogeographic categories was needed. We recognize the problems which, as Raup (1947, pp. 63 and 64) points out, make difficult the assignment of a given species to a particular phytogeographical subdivision. This is aggravated in the case of a species whose distribution may be disjunct at one or another extremity of its total range. However, on a purely pragmatic basis it is more useful for the present purposes to generalize the ranges rather than to particularize them. If the latter procedure is carried to its ultimate extreme the distribution of each species becomes a special phytogeographical case.

The general system of classification used by Scoggan (1950) has been somewhat modified and is our basis for characterizing

distributional patterns. A series of roughly latitudinal major headings are established; under each is a series of subheadings which is roughly longitudinal. Sharp classification according to such a scheme is not possible and a considerable degree of arbitrariness results. Even so, difficulty arises with North American species. When a species extends outside of North America only whole continents or subcontinents are considered. And when the limits of any one continent are transgressed the vexed question of whether a species should be described as *alpine* or *arctic* is further aggravated, simple though this problem seemed to Agassiz (1850).

The following terms for distributional categories are recognized:—

The roughly latitudinal categories—

Arctic—extending *north* of tree line.

Boreal—extending northward *to* the northern limit of northern coniferous forest.

Temperate—extending northward to the southern limit of northern coniferous forest.

Southern—extending to the southern limit of the hardwood forest.

Hyphenization of pairs of these terms indicates that the species transgresses the boundaries indicated. The known distributions of species justify this procedure, as do also the broad ecotones.

The roughly longitudinal subheadings—

Circumpolar—essentially continuous distribution around the world.

Amer-asian—general American distribution plus Asian stations.

Amphiatlantic—essentially eastern American distribution with transatlantic stations in addition.

American—more or less generally distributed in North America.

Eastern American—more or less generally distributed east of 100° W. long.

Mid American—more or less mid-continental.

West American—more or less reaching an eastern limit at 90° W. long.

In addition to the above we use the self-explanatory terms, Great Lakes endemic, and Cook County endemic.

The habitats occupied by the rarer plants falling in this section are:—*a.* the cold, wet rocks and ledges immediately along the shore of Lake Superior; *b.* the gravel, shingle, or cobble beaches along the shore of Lake Superior; *c.* the moist, shady cliffs and cool canyon walls, both along the Border Lakes and by Lake Superior; *d.* the dry, sun-baked south-facing cliffs and dry clifftops; *e.* the portage trails, stream banks, open glades and moist roadside ditches; *f.* the sub-aquatic and aquatic habitats.

a. The cold, wet rocks and ledges along the Lake Superior shore (Plate 1191)—The plants growing on the bare rock of the smaller points extending out into Lake Superior and on the nearby ledges which often are wave-swept are notably under the immediate influence of the low temperature of the lake water. Often spring- or seepage-fed pools or pools replenished during lake storms are abundant on the points. The individual plants found on the points may be rooted simply in cracks in the rocks as is so dramatically the case with *Sagina nodosa;* or they may occur, a few together, sharing a clump of moss at the side of a rock pool or a limited patch of raw gravel in a rock crevice. At the upper limit of the zone these plants are present in somewhat larger numbers of individuals in the sphagnous cushions about the bases of scattered shrubs, such as *Potentilla fruticosa, Physocarpus opulifolius, Kalmia polifolia, Ledum groenlandicum, Chamaedaphne calyculata, Vaccinium uliginosum,* and *Salix* spp.

Among the species found on these points and ledges are:—the widespread boreal or arctic circumpolar, *Selaginella Selaginoides, Deschampsia flexuosa, Tofieldia pusilla, Allium Schoenoprasum* var. *sibiricum, Polygonum viviparum, Empetrum nigrum, Vaccinium uliginosum,* and *Pinguicula vulgaris;* the arctic-boreal amphiatlantic *Equisetum scirpoides;* the boreal amphiatlantic *Sagina nodosa;* the arctic-boreal or boreal American, *Parnassia palustris* var. *neogaea, Primula mistassinica, Geocaulon lividum;* the boreal east American *Empetrum atropurpureum;* the boreal mid-American *Euphrasia hudsoniana;* and the Great Lakes endemic *Primula intercedens.* In general these are calcicolous or indifferent and occur in the Pigeon Point, Grand Portage, Grand Marais areas where the shore rocks are slates or basic phases of the diabase trap. Very few of these species occur away from the shore, two exceptions being *Allium Schoenoprasum* var. *sibiricum* which is found on a cliff at North Fowl Lake in the Rove slate region, and *Parnassia palustris* var. *neogaea* in a moist, marly roadside ditch near Schroeder. Nor is the whole group of species mentioned above found at any one locality. There is considerable randomness of occurrence.

b. The gravel, shingle and cobble beaches along the shore of Lake Superior—The contemporary beaches of Lake Superior in Cook County are typically composed of coarse ma-

terials and are rather sparsely vegetated except at the forested upper margins well back from the influence of storm waves. On these beaches may occur the temperate eastern American *Agropyron repens* f. *trichorrhachis* and *A. repens* var. *subulatum* f. *Vaillantianum;* and the boreal-temperate circumpolar (*sens. lat.*) *Lathyrus japonicus* var. *glaber.*

Notably absent from the beaches visited in Cook County is *Elymus arenarius* which occurs in quantity on the *sand* beaches farther east along the north shore of Lake Superior.

c. The moist, shady cliffs and cool canyon walls (Plate 1190)—Most productive in the search of these localized habitats in Cook County for rarities are the moist, shady faces and upper talus margins of the north-facing cliffs of the Rove slate area. These cliffs face on the elongated, deep lakes near the border and also on some of the bays set off by the larger points of Lake Superior (notably Pigeon Point). Also the shady and moist canyons cut by the streams dropping off of the tableland prove to be favorable ecological niches for the growth of this group of rarities. Common to these habitats are:—the presence of finely comminuted rock forming a constantly replenished and fresh soil at the upper margin of the talus slopes and on the niches and ledges of the cliff faces; the constant supply of moisture; the neutral to mildly basic country rock; the absence of forest tree root competition and of heavy tree-shade and of low pH of forest duff. All these factors seem peculiarly favorable to the presence of a striking number of rarities and even to the development of a small group of endemics.

As in the case of the rarities on the shore rocks, those of the moist cliffs and canyons are often almost random in their occurrence. Sometimes, as with *Saxifraga cernua* var. *latibracteata,* the species is known from Cook County (and Minnesota) from but a few square feet at the top of a single talus slope; sometimes, as in the case of the local endemic *Oxytropis ixodes,* it luxuriates over several acres of cliff and talus (Plate 1190-B) but is found on only one lake (in this case its var. *ecaudata* occurs similarly on the next lake north in the chain); or sometimes as in the cases of *Calamagrostis purpurascens* or the endemic *Poa scopulorum* (of the *Oreinos* group) or *Arnica chionopappa* (Plate 1190-C), it will occur on several cliffs. Most of the species are notorious calcicoles, and the remainder indifferent.

A wide diversity of distributional types exists among these species—including occasional "disjunct" distributions (although there are fewer of the latter than would have been interpreted as such a few years ago). Arctic or boreal circumpolar ranges: *Woodsia alpina, W. glabella, Carex supina, Allium Schoenoprasum* var. *sibiricum, Draba nemorosa* var. *lejocarpa,* the American representative of *Saxifraga cernua* (*sens. lat.*) and *Viola Selkirkii;* the temperate circumpolar *Asplenium Trichomanes;* and the American representative of the Arctic amphiatlantic *Saxifraga Aizoon* (*sens. lat.*). Several are Arctic or boreal Amer-asian—*Cryptogramma Stelleri, Calamagrostis purpurascens,* and *Cerastium beeringianum.* Several are boreal and temperate American—*Woodsia scopulina, Carex praticola, C. media, Polygonum Douglasii, Arabis Holboellii* var. *retrofracta,* and *Arnica chionopappa.* Temperate eastern American are *Cystopteris fragilis* vars. *laurentianum* and *Mackayi, Carex Backii, Draba arabisans* (*sens. lat.*); and mid-continental temperate American *Phacelia Franklinii.* There are also the Great Lakes endemic *Woodsia Cathcartiana* and the Cook County endemics *Poa scopulorum* and *Oxytropis ixodes* and its f. *ecaudata.*

d. The dry, sun-baked south-facing cliffs and dry cliff-tops—On some cliffs lithologically similar to those mentioned above but which are directly exposed to the sun, and in occasional gravelly openings in the woods on the caps of the cliffs, and on long, dry open rock slopes where recent weathering is producing gravel there occur other rarities than most of those mentioned above. These may be calcicoles, but often appear to be indifferent.

The species put in this category include the arctic-boreal circumpolar *Vaccinium uliginosum,* the temperate-boreal Amer-asian *Arenaria macrophylla,* the temperate amphiatlantic *Draba norvegica,* the boreal American *Carex deflexa* and *Shepherdia canadensis,* the temperate eastern American *Draba arabisans* (*sens. lat.*), the southern U. S. *Plantago virginica* (on very recently comminuted diabase trap along a shallow road cut), the temperate continental (mid-) American *Carex xerantica* and *Senecio eremophilus* (both of which reach their easternmost stations in Cook County or in the adjacent Thunder Bay District), and the Cook County endemic *Poa scopulorum.*

e. The portage trails, stream banks, open glades and moist roadside ditches—In these moist but transitory habitats occur some species which are notably calcicoles, as *Parnassia palustris* var. *neogaea*, but others often appear to be indifferent except to the ready availability of soil moisture. Again a variety of distributional types is represented; arctic circumpolar *Stellaria calycantha* and its var. *floribunda* and *Parnassia palustris* (*sens. lat.*); boreal circumpolar *Scirpus hudsonianus, Carex media* (which in the narrow sense is boreal American); temperate circumpolar *Pyrola minor;* temperate American, *Eleocharis nitida* and *Carex scoparia;* temperate eastern American *Elymus Wiegandii, Salix pellita* and *Chrysosplenium americanum;* and finally temperate western American *Crataegus columbiana, C. Douglasii* and *Rubus nutkanus* (*sens. lat.*).

f. The sub-aquatic and aquatic habitats.—In the shallower portions of some of the lakes and ponds or in adjacent wet meadows there may occur boreal American *Scheuchzeria palustris* var. *americana* and *Ranunculus Macounii;* temperate American *Elymus virginicus* (typical); boreal circumpolar *Subularia aquatica;* and boreal-temperate amphiatlantic *Eriocaulon septangulare* and *Lobelia Dortmanna.*

The accompanying table summarizes by habitat the number of species in each distributional category (Table I). Of the 70 species tallied in the Table, 22 are circumpolar (arctic-boreal-temperate), 4 are Amer-asian (arctic-boreal), 6 are amphiatlantic (arctic-boreal-temperate), 19 are American (arctic-boreal-temperate), 9 are east American (temperate), 2 are mid-American, 4 are west American, 1 is southern North American, and 3 are endemics (Great Lakes-Cook County).

Irrespective of the viewpoint, whether that of contemporary distribution, or that of the habitat occupied, it is clear that the rarer plants of Cook County are extremely diverse both in the types of ecological niches which they occupy and in their geographical affinities. Nor are they all calcicoles, some being indifferent. These plants cannot all be disposed of by assuming that they are "conservative" and unable to migrate. This is obviously untrue of some of them, such as those of the shore rocks and ledges, which have had these limited habitats available to them only for the brief time that the lowering water level of

TABLE I

Geographic Areas of 70 Rare Species Classified by Habitat in Cook County

	Arctic-boreal				Temperate						Endemics		
	Circumpolar	Amer-asian	Amphiatlantic	American	Circumpolar	Amphiatlantic	American	East American	Mid-American	West American	Great Lakes	Cook County	Southern N. A.
a) Cold wet shore rocks	8		2	4*							1		
b) Gravelly and cobbly beaches	1							2					
c) Shady moist cliffs and ravines	7	3	1	4	1		2	3		1		2	
d) Exposed dry cliffs	1	1		2		1		1	2				1
e) Portage trails, ditches, etc.	2			3	1		1	3		3			
f) Aquatic habitats	1			2		2†	1						
Totals	20	4	3	15	2	3	4	9	2	4	1	2	1

* including an east- and a mid-American
† boreal-temperate

Lake Superior and its predecessors have left these areas available for plant occupation. Nor can any of these species be dismissed as "relics" in the long accepted and Fernaldian sense of the term because until the northward retreat of the Rainy Lobe their present habitats were occupied by ice. The geological evidence clearly shows that the Arrowhead enclave has been available for occupation by plants only since late Rainy Lobe (Cary) time—presumably something more than 11,000 years ago.

The only common characteristics of the habitats in which our rarities occur are their limited extent, a newness which is perpetuated in any of a variety of ways, and the absence of effective biotic competition. They seem to represent the remnants of a sort of pioneer fringe. It is pertinent now to attempt a reconstruction of how these species, as well as the commoner elements of the Cook County flora, may have come to occupy their present places.

(*To be continued*)

Animadversions and Other Notes on Arnica.[1]—The specimens cited in this text are preserved in the following herbaria: DAO—Department of Agriculture, Ottawa, Canada. Lep—Private herbarium of Father Ernest Lepage, Rimouski, Prov. of Quebec, Canada.

[1] Contribution No. 1210, from the Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada.

Arnica attenuata Greene, *A. sornborgeri* Fern. var. *ungavensis* Boivin, Nat. Can. **75:** 211. 1949. As more Ungava specimens of this species gradually accumulate in our herbaria, it becomes clearer that var. *ungavensis* belongs with *A. attenuata* rather than with *A. sornborgeri*. The monocephalous condition, characteristic of the syntypes of var. *ungavensis*, is more common in Ungava than in the rest of the range.

The distribution map published in Brittonia **4:** 409. 1943 should be corrected as follows: the range of *A. sornborgeri* should be restricted to Labrador proper: the range of *A. attenuata* should be extended continuously across Northern Ontario eastward to include most of the Ungava territory, both its coastal region and much of the interior.

In the eastern part of its range *A. attenuata* appears to be the characteristic species of the flats and flood plains of the major watercourses.

Arnica frigida Meyer var. **glandulosa** var. n. Tegulis et hypocephalo elanatis sed minute glandulosis. Tegulae summae glabrae. Yukon: *J. A. Calder 3767*, about 20 miles east of Dawson on road to McQuesten, steep rocky slope by Klondike River, flowers yellow, occasional, July 17, 1949 (DAO type).

Similar to typical *A. frigida* Meyer in its general appearance and technical characters, but the lanosity of the tegules and of the hypocephalum is completely lacking, being replaced by a fine glandulosity.

Arnica fulgens Pursh. New to Manitoba: *Dore & Lindsay 11,108*, Souris District, Bede, conspicuous patches in full bloom on natural prairie, June 27, 1950 (DAO); *Dore & Lindsay 11,016*, Souris District, 10 miles south of Melita, growing in circular patches about 30 cm across in native prairie near bank of the Souris River, June 23, 1950 (DAO); *Dore & Lindsay 11,060*, Souris District, Medora, moist prairie pasture, June 26, 1950 (DAO).

Arnica lessingii (T. & G.) Greene, *A. porsildiorum* Boivin, Nat. Can. **75:** 210. 1949. Prompted by a note in Brittonia **4:** 488. 1943 that the type had not been seen and was presumably preserved in the Greene Herbarium, prompted also by the necessity of clearing some bibliographic and taxonomic difficulties in the interpretation of this species, I published in the

Nat. Can. **75:** 209–210. 1949 a note in which I selected as type of this species the Chamisso collection from Saint Lawrence Bay, cited by Lessing in his report on the Synanthereae of the Romansoff Expedition.

Soon after, Dr. Bassett Maguire published in vol. **52:** 281–3. 1950 of this journal a short paper, entitled "On the application of the name *Arnica lessingii* (Torrey & Gray) Greene," in which he selected again a new type for this entity.

Apparently both of us had overlooked an earlier and apparently quite satisfactory typification by Rydberg, North Am. Fl. **34:** 328. 1927. The earlier typification by Rydberg must stand unless demonstrably in error. It appears to be identical with that of Maguire and therefore the synonymy given in Rhodora **52:** 283. 1950 must stand as substantially correct.

Arnica plantaginea Pursh. Range extension:—Quebec, Ungava: *E. Lepage 14,598*, rivière aux Mélèzes, calcaires dolomitiques, 10 août 1945 (DAO); *Dutilly, Lepage & Duman 28,234*, rivière aux Mélèzes, Big Dolomite Hill, lat. 57° 35′, sur dolomie émiettée, 25 août 1951 (DAO); *Dutilly, Lepage & Duman 28,211*, mont au sud de la rivière aux Mélèzes, 13 miles en haut de la fourche, lat. 57° 35′, sur tablette de roc magnésien, 23 août 1951 (Lep).

This species appears to be confined to magnesian and dolomitic outcrops.—Bernard Boivin, Division of Botany and Plant Pathology, Department of Agriculture, Ottawa, Canada.

A New Hampshire Station for Heteranthera dubia (Jacq.) MacM.—Among the many new stations for aquatics discovered in the recent New Hampshire State Fish and Game Departments, "Wildfowl Waterways Survey" is one for Heteranthera, Post Pond, Lyme, Grafton Co., September 11, 1947, Krochmal. In a considerable series of specimens of "Potamogeton" set aside in the autumn of 1950 for critical study was this Post Pond collection which defied for a time all attempts at identification. Mr. Paul Giguere, now at Cornell University, while making a preliminary visit there accompanied a field class to Hatch Lake in Easton, New York on November 3, 1950. *Heteranthera dubia* was one of the aquatics collected during that

visit. It proved to be a good match for our unknown. Dole et al[1] make the following statement about its geographical distribution in Vermont, "frequent in the Champlain Valley." They do not mention its presence elsewhere in the state. The nearest Massachusetts stations from which specimens have been seen by the authors are West Springfield in the Connecticut Valley and Wenham in Essex County. In Maine, Ogden, Steinmetz and Hyland[2] record it from Aroostook, Penobscot and Waldo counties. Presumably, if the considerable number of herbarium specimens is any indication, it is quite abundant in the St. Lawrence River Valley in the general vicinity of Montreal.

Fernald[3] gives the following range statement for this species. "Streams and quiet waters or their argillaceous or calcareous shores. Florida to Texas and Mexico, n. to sw. Quebec, s. Ont., . . ." Some modification of the geographical data would seem to be desirable to specifically include Maine and New Hampshire. Post Pond perhaps satisfies the habitat requirement as stated in the foregoing quoted passage. According to Warfel, MacCoy and Foote,[4] P. 112, Post Pond has a pH of 7.0 down to a depth of at least 11 feet and becomes somewhat more acid at lower levels. R. J. Lougee,[4] P. 147, states "Post Pond . . . has a remarkably flat clay floor . . ." This collection is in the Herbarium of the University of New Hampshire.—A. R. Hodgdon, University of New Hampshire, Durham, New Hampshire; and Stanley B. Krochmal, New Hampshire State Fish & Game Department, Concord, New Hampshire.

Borrichia frutescens from Chesapeake Bay.—In the August 1951 number of Rhodora (vol. 53: p. 206), Dr. S. F. Blake effectively deleted the records of *Borrichia frutescens* (L.) DC., not only from the District of Columbia, but also from all shores inside the mouth of Chesapeake Bay. The next month I was exploring a saltmarsh near the end of Northern Neck, the peninsula between the Potomac River and the Rappahannock,

[1] The Flora of Vermont, 3rd rev. ed. 79, 1937.
[2] Vascular Plants of Maine. Bull., Josselyn. Bot. Soc. 8. 21, 1948.
[3] Gray's Manual of Botany. 8th ed. 397, 1950.
[4] Biological Survey of the Connecticut Watershed, N. H. Fish and Game Department Survey Rep't no. 4, 1939.

when I came on this curious composite. The simple flowering stems were only about a foot high, but the plants branched so much below ground that I could not tell whether it was one or several individuals. The specimen deposited in the U. S. National Herbarium is as follows:

VIRGINIA: Lancaster County: Lower edge of saltmarsh, Oyster Creek, September 15, 1951, *L. B. & C. C. Smith, G. Edwin no. 5577.*

Mr. J. Hubert Penson of the British Embassy informs me that he has found this species slightly further south on the other side of the Rappahannock, making a second record well within the Chesapeake Bay area.—LYMAN B. SMITH, DEPARTMENT OF BOTANY, U. S. NATIONAL MUSEUM.

A RANGE-EXTENSION FOR SUGAR MAPLE.—While botanizing in Northwestern Ontario in 1912 I gained the confidence of Ojibway Chief Penassie who daily patrolled the wooden pipeline which brought the city water for Ft. William from Loch Lomond several miles inland to the west. Penassie started us from his patrol line onto an obscure winter trail which was followed with difficulty but finally brought us to a cove on the southwest slope of Mt. McKay. Here was a fine grove of *Acer saccharum*, with several old trees in the center surrounded by successively younger trees outwards.

The older trees had been hacked and chips inserted from which the sap dripped into birch bark receptacles made by folding up the ends and sewing with black spruce roots. The birch bark wigwam in the middle of the grove proved a disappointment—it contained a white man's iron kettle.

Specimens collected by O. E. & G. K. Jennings & R. H. Daily, June 26, 1912, deposited in Carnegie Museum Herbarium. —O. E. JENNINGS, CARNEGIE MUSEUM, PITTSBURGH PA.

Additional Notes on Arundinaria gigantea.—In Rhodora **54:** No. 639 (1952) the writer reported flowering *Arundinaria gigantea* (Walt.) Muhl. from an area west of Sandusky in Alexander County, southern Illinois. This is the area in which short, basal flowering shoots were collected in July, 1951. The same area was re-visited on 24 April 1952 and on this date leafy flowering culms from four to five feet in height were observed and collected. On the same date an area west of Tamms in Alexander County was explored. An additional colony with tall, leafy flowering culms was revealed in this locality.

Flowering material from the 24 April collection was sent to the Smithsonian Institution, United States National Museum and the following comment was received from Mrs. Agnes Chase: "There are two Schenck collections of flowering *Arundinaria gigantea*, Mt. Carmel, Illinois 1879 (date not given) and June 10 and July 10, 1900, Wabash River, Wabash County." Mrs. Chase indicated that excepting a Gattinger specimen from Tennessee dated April 22 the Illinois collection of 24 April 1952 is seasonally the earliest flowering material in the herbarium of the National Museum.

Near Diswood, Alexander County, Illinois, the writer explored an extensive colony of cane on 28 May 1952. Only three leafy, flowering culms were seen in this area. All of the above areas were re-visited on 16 July 1952. No additional flowering material was observed at the time, and remaining culms which had been in flower in April appeared to be dead.

Flowering material from the 24 April collection, including both Tamms (No. 9006) and Sandusky (No. 9007), has been deposited in the following herbaria: Illinois State Museum, University of Illinois, United States National Museum, and Gray Herbarium.—Glen S. Winterringer, Illinois State Museum, Springfield, Illinois

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THE NEW ENGLAND BOTANICAL CLUB

Vol. 55 **March, 1953** **No. 651**

THE CHROMOSOMES OF DISPORUM MACULATUM[1]

Marion Ownbey

Chromosome studies on six of the seven species and varieties of *Disporum* (Liliaceae) native to North America have been reported by Jones (1951) in his comprehensive cyto-taxonomic study of this group. Attempts to secure cytological material of the seventh, *D. maculatum*, for his study, however, were unsuccessful. More recently, living material of this species has been obtained from two sources, and the present account completes the cyto-taxonomic survey of the North American representatives of this genus.

Material available for study included a seedling from plants transplanted originally from Black Mountain, Letcher County, Kentucky, supplied by Dr. E. Lucy Braun, and a plant furnished by Mrs. J. Norman Henry from a collection grown for many years in her garden at Gladwyne, Pennsylvania. There is some question about the original source of the latter plants, but Mrs. Henry is "almost sure" that she collected them near Little Switzerland, Mitchell County, North Carolina. A third plant from Adams County, Ohio, sent by Dr. Braun, did not survive to produce root tips.

The plants were grown outside at Pullman, Washington, and root tips taken in the autumn of 1951 ("Little Switzerland") and summer of 1952 ("Black Mountain"). The root tips were fixed in Belling's modified Navachin's fluid, sectioned at 15 microns, and stained with iodine-crystal violet.

The diploid complement of *Disporum maculatum* (fig. 1) consists of six chromosome pairs ($2n = 12$). The four longer pairs

[1] This investigation was supported in part by funds provided for biological and medical research by State of Washington Initiative Measure No. 171.

have unequal arms of varying proportions. On the fifth pair, no constriction could be detected in any of the material examined, but a thin, lightly stained terminal segment was usually evident. The sixth and shortest chromosome pair possessed submedian constrictions. No important differences in chromosome morphology were noted between the two collections. The chromosomes of "Black Mountain" were noticeably less contracted than those of "Little Switzerland," and the position of the constric-

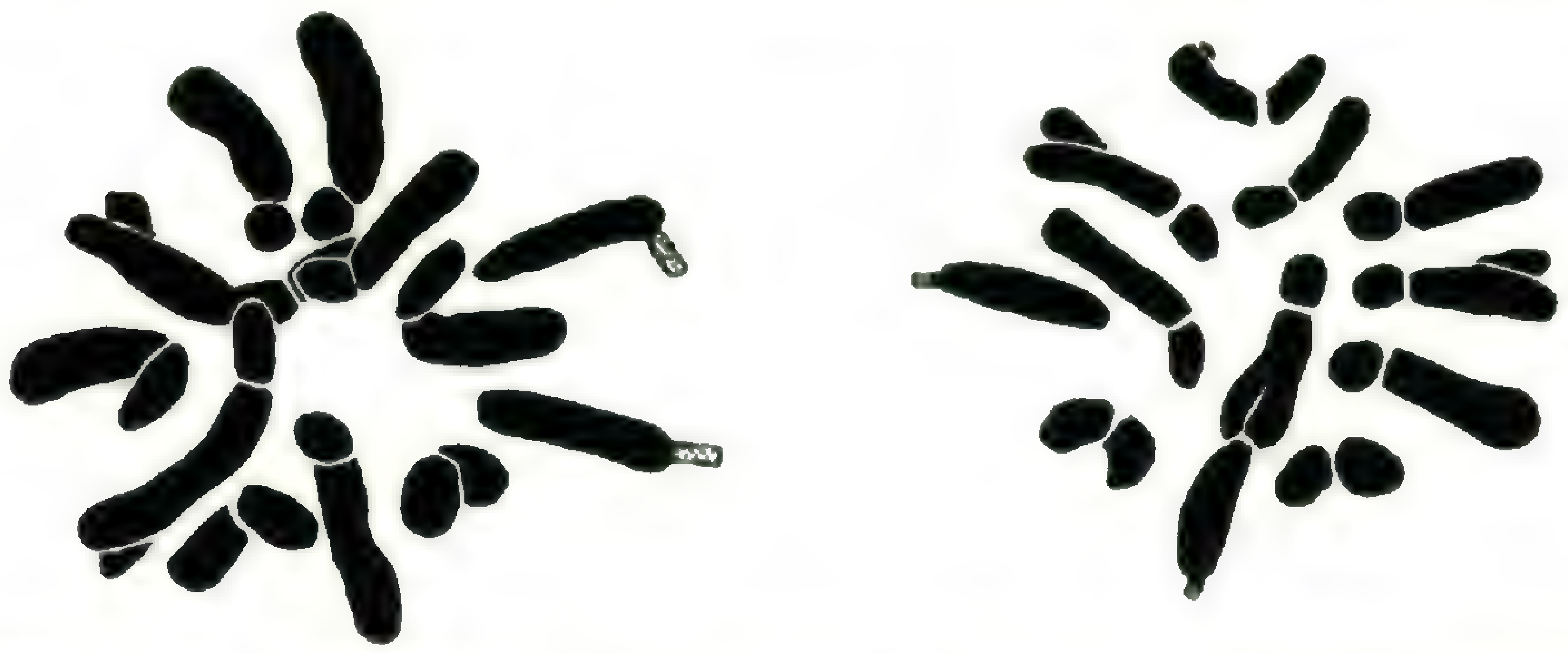

Figure 1. Chromosomes of *Disporum maculatum*. Mitotic metaphase from root tips. Left.—"Black Mountain." Right.—"Little Switzerland.", × 3100.

tions was not as clear. These differences are probably to be correlated with the temperatures prevailing at the time of fixation rather than attributed to inherent differences between the two collections. No satellites were found on the chromosomes of either collection.

Disporum maculatum adds a fourth base number ($n = 6$) to those known for the five North American species of this genus. Jones (1951) found *D. Smithii* to have $n = 8$, *D. Hookeri* (3 varieties) and the very similar *D. lanuginosum* to have $n = 9$, and *D. trachycarpum*, $n = 11$. All except *D. maculatum* have one pair of satellited chromosomes. These chromosomal differences are all the more remarkable in view of the striking external homogeneity—vegetatively, at least—of the group. These species today form a small isolated group (the section Prosartes), but the chromosome situation suggests that they represent but a remnant of a one-time large and complicated assemblage.—State College of Washington, Pullman.

Literature Cited

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A FLORISTIC STUDY OF COOK COUNTY, NORTHEASTERN MINNESOTA

Fred K. Butters and Ernst C. Abbe

(*Continued*)

7. Presumed History of the Flora of Cook County.

The contemporary flora of Cook County presents the picture of a sea of conifers diluted throughout much of its extent by the lesser hardwoods, such as birch and popple; there are a few islands of hard maple groves; it is dotted with many lakes with their characteristic margin and shallow water species, and also by many bogs; lacing through the forest are streams and rivers with their characteristically narrow zone of aquatics, etc.; and sporadically there occur the much restricted cliff, rock point and other transitory habitats which harbor most of the rarer plants of the county.

It is the rarer plants which immediately hold the attention. But they show no common features as to edaphic factors other than that the soil is new. Some are calcicoles, others quite indifferent. Even the calcicoles cannot be singled out for especial attention because many of the rarities are at the extreme limits of their ranges, and may well be occupying habitats which are atypical. Nor do these plants show common characteristics in relation to temperature and other microclimatic features. Some are found only along the cold zone immediately adjacent to Lake Superior, others only in the sunbaked openings in the conifer woods atop the cliffs.

These rarer plants cannot be disposed of as "pre-glacial relics" —the county was completely submerged under the ice of the Rainy Lobe. Preglacial and postglacial lakes have occupied other extensive areas since Cary time, so that some of the rarities occupy areas only very recently available.

A consideration of the geographical affinities of the plants of these transitory habitats again provides no simple and obvious solution to their current presence in Cook County. Some are at the northern, others at the western, or eastern, or southern limits of their contemporary ranges. In fact there might well be raised

the question of the value of elaborate analyses of the contemporary ranges, especially when the tacit assumption is made that they are static. Ideally the contemporary ranges should be related to the pollen analytical data, were these sufficiently complete (*cf.* Deevey, 1949). By analogy with the position of paleobotany in plant phylogeny, it is obvious that it is the stratigraphic analysis of plant remains (including pollen) which will help to clarify the meaning of contemporary distributional patterns; direct comparisons of contemporary distribution patterns are likely to be just as misleading as the old comparative morphology of living plants often was in arriving at sweeping phylogenetic conclusions. Similarly experimental taxonomy will ultimately help interpret contemporary distributions. Unfortunately the phytogeographer is not yet in a position to utilize these much-desired sources of information. Therefore it is necessary to fall back upon secondary sources of information in attempting to reconstruct the floristic history of the county.

It is not sufficient that the contemporary rarities alone be considered. Their present-day occurrence is so intimately related to the obvious competition provided by the coniferous forest that it and the other components of the flora of the county also require to be taken into account.

Whatever the specific viewpoint, the glacial history of Cook County forces the conclusion that every floristic element, every species (including the ancestral stock of the endemics) must have immigrated into the county since late glacial time, and have migrated considerably within the county once it had arrived. The one feature which all of the plants of the county share is the speed with which they are able to migrate. The following points may be taken as axiomatic in considering the "migration-potential" of the ancestors of the plants composing the contemporary flora of Cook County.

1. They were able to migrate according to any of a variety of means of dissemination, most or all of which are still operative.

2. They came from ice-free regions sufficiently close at hand so that the means of dissemination peculiar to each species could operate; the intervals in space which could thus be bridged vary markedly from species to species.

3. They probably had at least as great ecological amplitude as do their contemporary descendents in the area.

Furthermore it may be assumed that:—

4. Species whose occurrence in the county is disjunct are unlikely to be moving *into* it, but rather this is a manifestation of the disruption of a formerly more nearly continuous range.

5. The highly localized endemic in a geographically recent region is the product of recent speciation which can be rationalized on familiar cyto-genetical grounds coupled with progressive geographical isolation of the parental stock.

6. Some species will migrate independently in the absence of biotic competition given appropriate climatic and edaphic conditions; others will migrate only as part of a favorable community.

7. The interplay of climatic fluctuations and of geographic change, if sufficiently great, is certain to be reflected in the changing distributional patterns of individual species, and in mass movement of plant societies.

The following appears to be the simplest reconstruction of the succession of floristic events in Cook County, taking into account the probable interaction of the climatic, geographic and biotic factors cited in the preceding sections of this paper.

Phase 1. The retreat of the Cary ice; the Two Creeks Interval. The retreat of the Cary ice exposed an area of the Arrowhead which in part remained free of ice during the subsequent Mankato advance. The decay of the Rainy Lobe left great ice blocks stranded in the highly diverse glacial landscape. There were the extensive, unconsolidated ground moraines ranging from acid in the Saganaga granites area to quite calcareous in the Rove Slate area; scratched rock surfaces, stoss faces of cliffs. In addition to the melt water ponded about the ice blocks, there were glacial streams and rivers which coursed across the county, swelling and shrinking, changing, as new outlets formed in the nearby ice margin. On a smaller scale, pond and lake shores, and braided streams have continued to provide new surfaces continuously to the present.

The climate was "periglacial." Whether it was as much less severe as the low latitude suggests is open to question because of the probable southward displacement of the glacial highs. Furthermore the nearness of the great mass of ice, and the presence of numerous large ice blocks must have produced a locally cool climate.

In this cool zone adjacent to the main body of the ice the raw soil provided conditions ideal for the thrifty growth of many arctic and subarctic species. The circumstances were also favor-

able for the dissemination of the seeds of this group of plants. The smooth, essentially unbroken surfaces of the minor tongues of ice, the often glazed winter snow, the absence of trees to act as seed traps, combined with the winds at the margin of the ice provided a set of circumstances not unlike that farther north today. Porsild (1920) has pointed out the importance of the generally small size of the seeds of arctic plants as an adaptation for their dissemination; as he says, "l'utilité de graines et de fruits légers est incontestable dans un pays où le vent constitue l'agent de dissémination de beaucoup le plus important." The prevailing westerly winds gave the great group of plants moving in from the west and northwest a migration advantage over the amphiatlantic group. There may be visualized a gradual eastward drift of arctic and subarctic species, with but a slight progress westward of the amphiatlantic group. There was no doubt an actively interbreeding population of the commoner arctic and subarctic species in this periglacial zone; this is still reflected in the notorious polymorphism of so many contemporary arctic and subarctic species. In general this was aggravated by the innumerable fluctuations of the zone as the various lobes of the ice ebbed and flowed, and temporarily separated breeding groups were again brought into contact.

The width of the tundra "zone" is decidedly problematical; it may well have been discontinuous. Undoubtedly its width varied with the terrain, and was wider when the ice was in retreat. It was surely invaded early and actively by the hardier phase of the coniferous forest, probably most rapidly in the areas of ground moraine which the pioneer arctic species had already stabilized. The unstabilized ground moraine, the periodically inundated flood plains, the bare rock surfaces, the cliffs and their talus slopes would have been invaded more slowly by the forest. However, even these habitats were to a large degree invaded by the coniferous forest as the main mass of the ice receded so that drainage patterns in the county came into balance with precipitation, and as the decay of successive generations of the pioneer species provided humus between the coarser elements of the ground moraine, and as the talus engulfed the smaller cliffs. Wilson (1932, 1936) describes one type of forest presumably of this sort at the Two Creeks site. No doubt a similar

forest developed in Cook County during the Two Creeks Interval. However the arctic-subarctic element must have persisted in quantity in the bogs and on the numerous active talus slopes and in the cool pools and lakes and ravines.

Phase 2. The Mankato advance of the Superior Lobe and St. Louis sublobe (Figure 3 B & C). The Arrowhead region was cut off from the rest of the state by the Superior Lobe advancing westward in the Superior basin and the St. Louis sublobe coming down across the northwest corner of the state. Thus the Arrowhead enclave came temporarily into being. Into it was again introduced the periglacial group of pioneers, perhaps with new species added from the northwest as well as others from the east. However the Arrowhead enclave was sufficiently large so that the hardier phase of the coniferous forest was probably quite capable of surviving. The proglacial lakes of this phase were apparently numerous and the extensive lake shore and lake bottom habitats must have supported a large population of arctic-subarctic aquatics. Thus the arctic-subarctic element of the Rainy Lobe tundra was replenished from the periglacial tundra of the Superior Lobe and farther west from that of the St. Louis sublobe. The continued opportunity for introgressive hybridization in this floristic element seems impressive.

Phase 3. The Glacial Great Lakes (Figure 3 D). With the retreat of the Superior Lobe and of the St. Louis sublobe of the Mankato ice the huge mass of Lake Agassiz and the succession of lakes in the Superior basin came into temporary existence. The climate continued to ameliorate. During this phase the development of a succession of beaches and their occupation by appropriate species occurred on a magnificent scale. This may well have been the period of active immigration from the east of the so-called Coastal Plain element of the Great Lakes flora (*cf. inter alia,* Wilson, 1935). In the country which had remained free of ice and glacial lakes the gradual encroachment of forest on the pioneer fringe and bogs continued as the processes of weathering and erosion led to stabilization of talus slopes and drainage of bogs and lakes. On the other hand the cutting of canyons and of stream banks continued to provide new habitats for some of the pioneers, while the progressive dropping of the levels of the glacial lakes exposed new cliffs and points which were populated

from nearby similar habitats by other members of the pioneer element.

Phase 4. The post-glacial thermal maximum. Continued climatic amelioration permitted the northeastward extension of the hardwoods and even of some prairie elements. This was probably a period of extreme reduction in the extent of the ecological niches suitable for the arctic-subarctic element.

Phase 5. The slight refrigeration following the thermal maximum. Following the thermal maximum a slight refrigeration has led to the restriction of the hardwoods to small groves due to the re-encroachment of the coniferous forest. Probably the arctic-subarctic element has expanded during this phase, perhaps only on a minor scale as wave action and weathering have continued to create fresh surfaces on the cliffs and points.

The history of the contemporary plant cover of Cook County may be summarized as follows:

The oldest elements are those constituting the *Ledum-Chamaedaphne* bogs and the arctic-subarctic species precariously retaining their footholds on the cliffs and rock points. Presumably these species together occupied the periglacial pioneer zone as it migrated into the area next to the edge of the Rainy Lobe. This element was later fortified with new species and many new individuals of species already present by the reintroduction of a similar periglacial group along the front of the Superior Lobe (and farther west, of the Des Moines Lobe). The arctic-subarctic aquatics could also have enjoyed their hey-day in the proglacial lakes at this time.

The Cook County and Great Lakes endemics interestingly enough fall in this oldest floristic element—they are obviously closely related to, or possibly derived from, species of the arctic-subarctic group. The longest time and greatest isolation of breeding populations has contributed to this.

The history of this oldest group of species has been one of almost continuously progressive restriction of suitable ecological niches. The ones that are found there today are "relics" indeed, but relics of a floristic element which reached maximum areal development at middle latitudes *during the height of glacial activity.*

The coniferous forests pushed into the Arrowhead enclave hard on the heels of the plants of the arctic-subarctic fringe and actively took over all suitable habitats.

Only temporarily at the time of the thermal maximum were conditions suitable for an invasion by the hardwoods and some of the prairie species. These enjoyed but a brief period of expansion and have been pinched off into very limited areas by the southward surge of the coniferous forest during the current period of mild refrigeration.

8. Comparison with Other Presumed refugia in Boreal Eastern America

The picture reconstructed above of necessity shows every floristic element of Cook County immigrating into it in late-glacial or in post-glacial time. No alternative is possible because of the glacial history of the county. No recourse is taken in a replenishment of the flora of the North Shore of Lake Superior from a convenient pool of "cordilleran" or "arctic" rarities in the Driftless Area. Any mysterious means of establishing this pool in the first place, or visionary method of getting species no longer represented there up to the North Shore of Lake Superior, requires far more in the way of botanical legerdemain than the procedure proposed above.

It is recognized that Hultén (1937) repeatedly calls for lack of glaciation "on the islands in Lake Superior" or nunatak "districts about the Great Lakes," and that his Plate 43 shows one of the "isolated refugia for biota" in the Nipigon region of the North Shore of Lake Superior. While Hultén follows a somewhat different path in arriving at a conviction that such "non-glaciated" areas exist about the Great Lakes, his fundamental views on this score follow those expressed by Fernald (1925) in his famous essay on "Persistence of Plants in unglaciated Areas of Boreal America" and in subsequent papers. These views are well known and have been reviewed with sufficient frequency (*cf. inter alia,* Raup, 1941; Deevey, 1949) so that detailed recapitulation here is unnecessary. However, some of the areas assumed to have been *refugia,* or "nunataks," or unglaciated areas in the Great Lakes region may be briefly listed and alternative views on their glaciation reviewed.

We may well begin with the North Shore of Lake Superior of which Cook County forms a part. Cook County has been shown to have been completely covered by the Rainy Lobe of the late Cary by Sharp (in prep.). A collecting trip by one writer as far east as Jackfish, Ont., during the summer of 1951 verified the existence there of many of the characteristic rarities of Cook County on cliffs and rock points along this part of the shore of Lake Superior. Many of the areas were submerged under glacial Lake Duluth and therefore possess the same type of raised beaches found in Cook County; the higher points (such

as the top of the Sleeping Giant opposite Port Arthur and Fort William) are not as high as the Misquah hills of Cook County, but like the latter are heavily scored by glacial striae (Tanton, 1931; Leverett, 1929). There is no reason to plead a special case geologically for this area—until it can be demonstrated otherwise, it must be assumed to have shared with immediately adjacent Cook County a common glacial history. It also shares with Cook County botanical rarities, lithological, physiographic and climatic features which make plausible a common floristic history for the whole of the North Shore (at least from Cook County to Jackfish, Ont.). This explanation must assume complete glaciation during the late Wisconsin and the subsequent immigration into the region of *all* components of the vegetation in late- and post-glacial time. Hultén's (1937) deductions concerning the region are wholly untenable.

Isle Royale is a long-famous "haven" for rarities. Perhaps the abundance of these is due in a large part to the absence of fire (Cooper, 1913). Cooper (1913), Leverett (1929), and Brown (1937) recognize that it was completely submerged under Lake Duluth. The first steps in its re-population must have come even later than that of Cook County, including the "cordilleran" element.

The Keweenaw Peninsula on the south shore of Lake Superior is another locality notorious for its rare plants (Fernald, 1935), but it was shown by Bergquist (1937) that it was recently glaciated, and by Leverett (1929) to have protruded but little above the waters of Lake Duluth.

Each of these areas on Lake Superior supports a flora which includes rarities; but each area has also been independently checked geologically whereupon it fails to satisfy the requirements for a nunatak or refugium. The plants are there *now*, but occupy areas recently covered by ice or still more recently submerged under the water of glacial lakes. It becomes necessary, if a nunatak theory is to be maintained as a philosophical necessity, either to relegate such refugia to still unexplored areas or to retreat southward to the Driftless Area. Either procedure demands that the rarities of today migrate across a terrain already heavily mantled by vegetation. It is far more reasonable to recognize the limitations of these species which restrict them

to migration under the more favorable conditions for dissemination found in a periglacial zone in late glacial time, or along the strand and shore rocks and cliffs of the glacial lakes.

These observations might be extended still farther east. Stebbins (1935) is sharply opposed to the Fernaldian concept of "persistence" as applied to the cordilleran rarities of the Bruce Peninsula on Lake Huron. He properly calls attention to Fassett's (1931) objection to Fernald's (1925) hypothesis that the "cordilleran" element of the Great Lakes flora survived in the Driftless Area and migrated in post-glacial time to their Great Lakes localities. Instead Stebbins, with especial emphasis on the Bruce Peninsula, advocates and implements the view which Fernald (1925, p. 292) discarded. In Fernald's words this is, "It is wholly conceivable that the isolation about the Gulf of St. Lawrence and in the cordilleran region of many plants is due to a gradual migration during the late stages of the Pleistocene along the cold fronts of the continental ice-sheets, the plants now restricted to cold and alpine or bleak habitats about the Gulf of St. Lawrence and in the West having found, upon the disappearance of the ice, congenial habitats in the Northeast and in the Northwest and occasionally about the headlands of Lakes Huron and Superior; the hot and dry summers of the lower or flatter areas between these three isolated regions soon proving wholly forbidding to these species, with the inevitable result that they have quite vanished from the broad intermediate regions. Such an explanation would be at once simple and reasonable and it is entirely possible that some interchange of this sort actually took place."

In the Gulf of St. Lawrence region the geological evidence again fails to support the nunatak hypothesis. This was brought out emphatically by Wynne-Edwards in his critiques (1937; 1939) of Fernald's views. In his detailed study of the Gaspé-Bic area, Scoggan (1950) confirms in detail the presence there of its characteristic rarities and cites Alcock's testimony that it was not in any part a nunatak area. The latter view is supported in a modified form by Flint, Demorest and Washburn (1942). Similarly MacClintock and Twenhofel (1940) consider that the Long Range of Newfoundland was glaciated, and Flint (1940) states that "Newfoundland was strongly glaciated during the latest (presumably Wisconsin) glacial age." Other botani-

cally significant areas are the Mingan Islands and Anticosti. These unquestionably were heavily glaciated and subsequently submerged under the waters of the Champlain Sea. Farther east at the Straits of Belle Isle the sharp line at the upper limit of this submergence is marked by the numerous perched boulders above it. In 1929 Dr. Harrison F. Lewis and the writer made an inland excursion (Lewis, 1931) to the top of Mt. Cartier (elev. 1264 ft.) near Bradore Bay to determine the upper limit of these erratics and found them even on the very summit. Nor was there botanical evidence even at this elevation of this having formerly been a "nunatak"!

Farther north the writer (Abbe, 1936) in examining the flora of the Kaumajet and Torngat regions found on the mountain tops a flora composed of the hardiest of arctic species. The "cordilleran" species occur at lower elevations. The geological evidence led Odell (1933) to the conclusion that the highest points of these two areas were inundated by the Labradorian ice. It was concluded that if, contrary to the geological evidence, nunataks had existed here at the height of glaciation they would have supported the growth of only the ubiquitous, arctic forms such as now grow on these mountain tops. Therefore the "cordilleran" element could only have survived on the precipitous ice-free forelands (by analogy with Greenland) or, if the forelands were also ice-covered, there must have been immigration of *all* floral elements during post-glacial time. The source of these was assumed to be in the "driftless areas of the St. Lawrence region." The geological evidence which has become available since 1936 makes it extremely unlikely that such refugia existed to the south. It becomes necessary to adopt for this area the same conception that I have adopted for the Cook County area, and which logically applies to the entire intervening region peripheral to the last ice sheets. The relics, including the "cordilleran" ones (which actually cannot be sharply differentiated from the arctic-alpine group), are relics of a late-Wisconsin dispersal; migration was most active when the maximum areas were temporarily available for dispersal and colonization and before the encroachment of the boreal forest. Subsequent survival at the periphery of the glaciated area suggests, for the rarities, the existence of suitable ecological niches *through* the climatic optimum.

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9. The Botanical Exploration of Cook County

It might well be expected that the first botanical records for Minnesota would be from Cook County because of the presence there of Grand Portage, the pre-Revolutionary "commercial emporium" of the fur empire of the old North West. But botanizing in the North West began after the trade routes had shifted away from Grand Portage—and the botanical collector tends to follow paths kept open by commerce or governmental agencies. Thus information was piling up concerning the flora of the regions to the west and south (*cf.* Upham, 1884) and immediately to the east (Agassiz, 1850), but not for our area (at least, insofar as records in the Herbarium of the University of Minnesota are concerned).

The first significant and usable collections from Cook County that are represented in the Herbarium of the University of Minnesota were made in the summer of 1879 by Thomas S. Roberts (1880), then a student at the University. Roberts was later to become a famous doctor in the Twin Cities, an outstanding authority upon birds, and ultimately the founder and the first director of the Museum of Natural History at the University of Minnesota. Roberts, with other members of a small party, including Professor C. W. Hall (1880), the geologist, made an

adventurous trip by boat from Grand Marais to Duluth during the summer of 1879, spending the latter part of July and much of August in Cook County. Only the previous year a government trail had been opened from Duluth to Grand Marais, but this, according to Hall (1880), was "chiefly for the dog trains that carry the Canadian mails . . . when navigation . . . is closed by the ice." The country was an essentially untouched wilderness, so that the party of necessity confined its activities primarily to the shore, but with trips inland to Devil's Track Lake and to Carlton Peak. The party spent several days at Grand Marais (then a "settlement" of but one house!) and while there collected several specialties of "The Point"—notably *Polygonum viviparum, Primula intercedens, Euphrasia hudsoniana,* and *Pinguicula vulgaris.* Farther west along the shore at Black Point, Roberts collected the very rare *Calypso bulbosa* and at the Cascade River, *Cystopteris fragilis* var. *laurentiana* (a variety not since collected in Cook County).

A considerable number of specimens was collected along the North Shore during the summer of 1878 by B. Juni (1879); however, the label data are so scanty that the plants seldom can be assigned to a specific locality, nor is the information given in his published list of great help in this regard.

The next major collections from Cook County were made in June and July, 1891, by L. S. Cheney and F. F. Wood (*cf.* Cheney, 1893) who made a canoe trip along the Border Lakes following Mackenzie's toilsome route westward from Grand Portage. Their collections are numbered separately, but it is evident from a comparison of their itineraries as based on their label data and from Cheney's report (1893) that they were working together. Most of the "good" records are credited to Cheney in the annotated list which follows this, perhaps because of some accident of distribution of the duplicate sets found in the Herbarium of the University of Minnesota. Before starting their trip inland by way of the ancient canoe route along the Border Lakes, Cheney and Wood collected at Grand Marais and there made important additions to Roberts' records, namely, *Selaginella Selaginoides* (subsequently collected but seldom in Cook County), *Luzula parviflora, Tofieldia pusilla* (otherwise known in Minnesota from Two Harbors down the Lake Superior

shore), *Listera auriculata* (otherwise known in Minnesota only from Grand Portage and Duluth), *Ranunculus lapponicus* (as reported in Cheney's list, but not represented in the Herbarium of the University—certainly one of the rarest of Minnesota plants), *Halenia deflexa*, and *Phacelia Franklinii* (not again collected in Cook County until 1937 at Mountain Lake). They went on to Grand Portage and there found *Vaccinium uliginosum* (collected only once again in the county in 1937) and *Castilleja septentrionalis* (not yet re-discovered in Cook County). In spite of their eye for rarities, Cheney and Wood oddly enough seem not to have collected any of the equally significant and localized species which occur on the cliffs and the talus slopes along the Border Lakes—perhaps because their schedule forced them into a haste which did not allow them time for the necessary scrambling and painstaking search involved in working the cliffs.

Conway MacMillan, founder of the Department of Botany at the University of Minnesota, visited the Border Lakes in Cook County in early September, 1895. On this trip his primary botanical objective seemed to be lower forms as it seems to have been on other trips to the county (*cf.* Conklin, 1942) because a search of the University of Minnesota Herbarium has brought to light no vascular plants collected by him at this time. He was at Grand Marais and Carlton Peak again in 1900, but again collected few vascular plants.

In August of 1901 MacMillan again went to Cook County, accompanied by two of his students, Charles J. Brand (later to become a well-known economic consultant and agricultural administrator) and Harold L. Lyon (subsequently Director of the Experiment Station of the Hawaiian Sugar Planters' Association). This was a walking trip along the Gunflint Trail to the Border Lakes. The trip yielded first records of those elusive aquatics *Isoëtes macrospora* and *I. muricata*, not collected again from the county for many decades. Mr. Brand has described this trip in a long letter[5] from which the following is taken.

"A small but comfortable lake boat transported us from Duluth to Grand Marais. During much of the trip the shore was in view, and I always remember with amusement that when Professor MacMillan pointed out the mouth of the Temperance River he told us it was so

[5] *In litt.*, November 14, 1947; omissions from the quotations given above not indicated.

called because the wit who christened it discovered that the usual sand bar was missing at the mouth of the river where it flows into Lake Superior.

"On arrival at Grand Marais, we went immediately to the little clapboard, tarpapered hotel. In those days the village appeared to have about 100 inhabitants, and the whole surrounding territory had only a small sprinkling of settlers, a few of them white families but most of them Indians. Dr. Mayhew and one of his kinsmen also owned the trading post where timber cruisers, prospectors, and occasional geologists and other scientists like ourselves outfitted to invade the hinterland.

"The tramp up the Gunflint Trail was tough in some ways for rather soft white-collar workers, but we enjoyed every hour of it. From the Brule we toiled on to Hungry Jack Lake where we took our canoes and went to South Lake, then to North Lake, and finally to Gunflint Lake on the International Boundary, portaging where necessary. The most striking discomfort of the trip came after we got into the Gunflint and Saganaga Lakes area where billions of mosquitoes and gnats infested the air above the small islands, actually forming clouds.

"At the conclusion of our botanical explorations, we proceeded to the town of Gunflint which was the western terminus of the even then outmoded Port Arthur, Duluth and Western Railroad. We took train to Fort William and Port Arthur. We had been out about a month, sleeping on pine boughs under the sky, so that our first night in the hotel in Port Arthur almost suffocated Lyon and me, and we placed our bedding on the floor of our room in order to be able to breathe and sleep."

Obviously collecting in those days was carried out under difficulties not unfamiliar to the camper and canoeist of today in the same region.

It was at about this time (1897) that J. M. Holzinger collected lower forms in Cook County (*cf.* Evans, 1899). He also added at least one important record among the higher plants—*Cypripedium arietinum* at Gunflint Lake, not again collected in the county. Holzinger again collected hepatics in Cook County in 1902 (*cf.* Evans, 1903).

In 1906, Lyon returned to Cook County, collecting in the vicinity of Grand Marais and there added the rare *Equisetum scirpoides* to the record.

In 1912, Professors C. O. Rosendahl and N. L. Huff spent part of August in the county, most of their collections being from the vicinity of Kimball Creek, where they found *Chrysosplenium americanum*, later collected in the county only at the Devil's Track River by Butters and Rosendahl in 1924.

The first extensive collections from Cook County were made by Professors F. K. Butters and C. O. Rosendahl early in the

summer of 1924. It is no mere coincidence that this was the era of the Model T Ford and that old Highway No. 1 (see Rosendahl and Butters, 1925), from Duluth to the Canadian border at the Pigeon River had been opened but a few years previously and had been improved as far as Little Marais the year before. The area in which they collected followed the course of the highway eastward along the shore of Lake Superior and then swung inland back of the Grand Portage area. Several important additions to the flora were made on this trip:—*Woodsia alpina*, one of the rarest of Cook County ferns was found at the Devil's Track and Poplar Rivers; *Poa saltuensis* at the "Carribeau" River and its variety *microlepis* at Mineral Center (and not again collected in the county); *Listera convallarioides* at Mineral Center (the only record for Minnesota); and the very local *Saxifraga virginiensis* at the Pigeon River.

It was in 1927 when Dr. Butters was on a non-botanical trip with a group of friends that his interest in the flora of the county as such was actively kindled. He stopped in at Grand Portage to visit his friends, Professor and Mrs. Solon H. Buck, historians who were on a sort of busman's holiday in this most historical of spots in Minnesota. While there, although it was September, Dr. Butters noted the occurrence not only of some of the specialties already known from "The Point" farther west at Grand Marais, but he also found *Sagina nodosa*, and on a similar visit two years later (also in September) found *Woodsia glabella* and *Cryptogramma Stelleri*.

Mr. and Mrs. F. R. Benner, high school teachers in Minneapolis and former students in the Department of Botany at the University, made an extensive collection while vacationing at Grand Portage during July and August of 1929. Their general collecting established a sound basis for a knowledge of that area, and they added to the list of rarities *Parnassia palustris* var. *neogaea*.

Dr. Rosendahl returned to Cook County in August 1929 with P. A. Rydberg who was visiting the Herbarium of the University while preparing his *Flora of the Prairies and Plains*. Rydberg and Rosendahl collected primarily in the Grand Portage area and added several new records to the flora of the county:—*Stellaria calycantha* (typical), unknown elsewhere in the state;

Crataegus Douglasii, a western hawthorn thoroughly at home in the thickets at Grand Portage; and *Empetrum atropurpureum* from Susie Island near Grand Portage.

In August 1930, Butters and Rosendahl again visited the Grand Portage area and made a brief side trip afterwards to some of the lakes in the Rove Slate area. The latter part of the excursion was made largely on the basis of the interesting reports which their friends Professors Grout and Schwartz of the Geology Department were bringing back as a result of their field work in that area. At and near Grand Portage Butters and Rosendahl made several significant new finds:—*Dryopteris spinulosa* var. *dilatata* on Lucille Island and at Grand Portage, the first and only collections in Minnesota; *Scirpus hudsonianus*, *Spiranthes Romanzoffiana*, and *Viola adunca* var. *minor* at Grand Portage; *Crataegus columbiana*, var. *Piperi* at the site of Fort Charlotte.

Dr. Butters and his student Murray F. Buell (now a Professor at Rutgers University) made the Border Lakes in the Rove Slate area their major objective in July of 1932. Here they found still more rarities growing on the slaty cliffs and talus slopes. They explored the Clearwater Lake cliffs especially, finding there *Woodsia scopulina* (which had turned up earlier at Grand Portage), *Danthonia spicata* var. *pinetorum*, a *Poa* of the *laxa* group which was later to be described as *P. scopulorum* (Butters and Abbe, 1947) known so far only as Cook County endemic, *Saxifraga Aizoon* var. *neogaea* (Butters, 1944), and the exciting *Arnica chionopappa* (Plate 1190-C) localized on only one talus slope in Cook County and known otherwise in Minnesota from farther west along the shore of Lake Superior where it was later found by Professor Olga Lakela. At near-by East Bearskin Lake, Butters and Buell turned up the infrequent *Eriocaulon septangulare*.

Etlar Nielsen, then a graduate student working on *Amelanchier*, made his first collecting trip to Cook County in September, 1932, and in the course of his general collecting at Clearwater Lake found *Polygonum Douglasii*, not again collected in Cook County. Nielsen made three more trips to Cook County, one with F. Egler in June of 1933, another with W. J. Breckenridge, now Director of the Museum of Natural History at the University of Minnesota, in June of 1935, and a third with Dr. J. W.

Moore in October of the same year. On the basis of the collections of *Amelanchier* made on these trips, Dr. Nielsen has published a very complete inventory of the *Amelanchiers* of the state. The following were collected in Cook County for the first time by Nielsen: *A. huronensis* Wieg.; *A. humilis* Wieg., var. *compacta* Nielsen; *A. mucronata* Nielsen (an endemic species known only from Clark's Bay), *A. Wiegandii* Nielsen, *A. canadensis* (L.) Medic.

In June, 1936, Dr. Butters and the junior author visited Cook County. The Border Lakes (Plate 1190-A) again received careful attention which was rewarded by several new records for the state as well as for the county:—*Carex deflexa* from Clearwater Lake, and *C. xerantica* and *Osmorhiza obtusa* from near-by Watab Lake. The rare *Carex Backii* known from only three other localities in Minnesota was found at Watab Lake, and *C. supina* (reported under its synonym *C. obesa* All., var. *minor* Boott by L. H. Bailey, 1892, from South Fowl Lake on the basis of an F. F. Wood collection) was collected at Clearwater Lake.

In July, 1937, Dr. Butters, Mrs. Abbe and the junior author collected again along the Border Lakes and at Grand Portage. At Mountain Lake we collected *Calamagrostis purpurascens* not previously known from Minnesota, and there Mrs. Abbe found an exceptionally limited colony of *Saxifraga cernua* var. *latibracteata* also new to the state. On the dry edges of the bluffs of Watab Lake *Arenaria macrophylla* was discovered, and out on Pigeon Point *Deschampsia flexuosa*, another "first" for the state. Mrs. Abbe and the junior author returned to the Grand Portage area for a few days in August of 1937 and then found *Draba norvegica* on Susie Island, a new record for the Great Lakes basin, and just over the International Border on the north side of Pigeon Bay (in the Thunder Bay District of Ontario) *Senecio eremophilus* which has not yet been collected in Minnesota. There also Mrs. Abbe found on the sun-baked cliffs a hybrid *Woodsia* which Dr. Butters (1941) subsequently named *W.* × *Abbeae* for her.

The following year (1938) Dr. Butters returned in early July to the Rove Slate area, taking with him G. W. Burns and M. J. Hendrickson, then graduate students in the Department; the former is now on the staff at Ohio Weslyan University and the latter is with the Hormel Research Foundation. At Mountain

Lake the trio added *Asplenium Trichomanes* and *Arabis Holboellii* var. *retrofracta* (the only record for the state). Throughout July and into early August, Burns and Hendrickson continued collecting systematically in the Rove Slate area, making the notable discovery at South Fowl Lake of a puzzling *Oxytropis* which was in a sterile condition. At Clearwater Lake they added *Carex ormostachya*, a new record for Minnesota.

Dr. Butters was much intrigued by the unknown *Oxytropis* which Burns and Hendrickson had located and accompanied by Dr. J. W. Moore made a brief trip in early July of 1939 in an attempt to find it in flower. In this objective he was unsuccessful, but as usual several new records were obtained:—*Botrychium multifidum* var. *intermedium* at John Lake; *Equisetum palustre* (apparently the European typical state), *Habenaria dilatata*, and *Microstylis unifolia*, all at Grand Portage.

Dr. Butters was determined to get flowering and, if possible, fruiting material of the unknown *Oxytropis*, so with this object in mind he returned to Cook County in late June and early July, 1940, with the junior author and G. W. Burns as companions. This time the quest was successful and an abundance of the endemic *Oxytropis* in flower (Plate 1190-B) was obtained on the American side of South Fowl Lake—this to be subsequently named *O. ixodes* Butters and Abbe (1943); also a well-marked form of it, *O. ixodes*, f. *ecaudata* Butters and Abbe was found on the Canadian side of North Fowl Lake. Along with the latter were also found *Carex Rossii* (known in Minnesota only from Carlton County), and *Cerastium beeringianum* (not yet collected in Cook County). From the American side of North Fowl Lake we collected *Shepherdia canadensis*, very uncommon in Minnesota; and at South Fowl Lake, *Ranunculus Macounii* (known from two other localities in Minnesota). Later during this same summer Professor Olga Lakela made at Sea Gull Lake the only collection of *Cypripedium Calceolus*, var. *parviflorum* for the county. In her characteristically enthusiastic and meticulous fashion she has also collected in Cook County during 1941 and 1944, on the latter occasion making at Schroeder the only collection for the county of *Potentilla gracilis* var. *pulcherrima*.

Dr. Butters' last summer of field work in Cook County was from late July to mid-August, 1944, when the junior author

again accompanied him. The object of this trip was to check the manuscript of the accompanying Annotated List (Section 12) in the field and to add to it such records of weeds, aquatics, etc., as may have been passed over during earlier intensive searching for the rarities of the county. We also wished to check a possible new species of *Poa* at its type locality on Clearwater Lake before publishing on it. The *Poa* turned out to be readily recognizable in the field and was subsequently described as *P. scopulorum* Butters and Abbe (1947), an endemic of the *P. laxa* group. In addition to checking our records and adding a number of weeds, several new records for Cook County were obtained on this trip:—*Botrychium matricariaefolium* at Lima Mountain, *Subularia aquatica* at Poplar Lake (the only collection for the state), *Elymus Wiegandii* and *Salix pellita* (new to Minnesota) at Grand Portage, *Plantago virginica* along the roadside west of Grand Marais (new to Minnesota and curiously out of range), and in a roadside ditch near Schroeder, *Eleocharis nitida* and *Liparis Loeselii*. It was on this trip that we found, much to Dr. Butters' delight, *Betula pumila* var. *glandulifera* for the first time for the county. It is by no means a rare plant in Minnesota generally, but in Cook County had evaded us for many years. Dr. Butters had predicted that it would turn up when the acid Archean granite country was carefully searched, since it seemed to be consistently absent from the neutral and basic country in which we had spent most of our time previously. It was a minor triumph for Dr. Butters when it proved indeed to be present in quantity in the bogs of the extreme northwestern part of the county.

There remained as botanically unexplored the western part of the county in the general vicinity of Sawbill Lake. When therefore John De Q. Briggs, headmaster of St. Paul Academy, and his accomplished wife, Mrs. Marjorie W. Briggs, both excellent amateur taxonomists, offered in 1945 to collect for us at Sawbill Lake we accepted with alacrity. We knew that they and their son, Winslow Briggs, were most discriminating and successful orchid hunters, so we were not surprised, although we were nonetheless pleased, when they came back with *Pogonia ophioglossoides* and *Arethusa bulbosa* as new records for the county; to these they had also added *Scheuchzeria palustris*. On a subsequent trip the Briggs turned up *Habenaria psycodes*, another

novelty for the county, thus continuing to add to their laurels as orchid specialists.

From the Department of Botany, Dr. and Mrs. Schuster, although primarily concerned with Hepaticae, collected some vascular plants in the summers of 1947 and 1948. Records of rarities have been verified, and additions, such as *Triglochin palustris* and *Houstonia longfolia*, made. Dr. and Mrs. Ownbey visited Cook County in August of 1948 and then turned up *Empetrum nigrum* and *E. atropurpureum* on the Susie Islands off Grand Portage.

While their objectives in carrying on botanical work in Cook County did not allow their representatives time to collect appreciable numbers of specimens, the Minnesota Department of Conservation and the U. S. Forest Service should be mentioned here as having contributed to a knowledge of the flora of the county. Through the good offices of Dr. J. B. Moyle of the Minnesota Department of Conservation, representative collections made by field men working in Cook County have been deposited in the Herbarium of the University of Minnesota. And a number of collections made in Cook County by U. S. F. S. employees have been made available by Mr. D. M. Stewart, Pathologist in Charge of Blister Rust Control, of the Duluth office of the U. S. D. A., Division of Plant Disease Control. Mr. Stewart himself has had extensive field experience in Cook County in connection with white pine blister rust control and has generously shared his information with us.

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10. Summary of Major Collections from Cook County

A summary of the more important collections is presented in the following table. Only those collections which total more than a hundred numbers have been included, except in the case of the first collection from each of the three regions into which, for the sake of convenience, the county has been subdivided. The collections are arranged in alphabetical order of collector by identifying initials. It is these identifying initials which are used in the Annotated List which constitutes Section 12 of this paper.

TABLE II

Summary of Major Collections from Cook County, Minnesota

Collection Numbers	Collectors	Date	Lake Superior watershed west of Grand Portage	Vicinity of the Border Lakes	Pigeon Point area including Grand Portage
AA 500–610	Abbe, L. B. & E. C.	Aug. 18–21, 1937			x
Be 467–704	Benner, F. R. & J. S.	Jul. 27–30; Aug. 20–29, 1929			x
Bg 1–124	Briggs, J. DeQ. & M. W.	Aug. 2–16, 1945	x		
BsH 152–430	Burns, G. W. & Hendrickson, M. J.	Jul. 17–Aug. 7, 1938		x	
B	Butters, F. K.	Sept. 1–3, 1927			x
BA 1–219	Butters, F. K. & Abbe, E. C.	Jun. 20–30, 1936		x	x
BA 754–1090	Butters, F. K. & Abbe, E. C.	Jul. 27–Aug. 15, 1944	x	x	x

TABLE II—*Continued*

Collection Numbers	Collectors	Date	Lake Superior watershed west of Grand Portage	Vicinity of the Border Lakes	Pigeon Point area including Grand Portage
BAA 220–470	Butters, F. K. & Abbe, L. B. & E. C.	Jul. 2–14, 1937		x	x
BABs 611–713	Butters, F. K. Abbe, E. C. & Burns, G. W.	Jun. 27–Jul. 3, 1940		x	
BBl 328–478	Butters, F. K. & Buell, M. F.	Jul. 7–19, 1932		x	x
BBsH 1–151	Butters, F. K., Burns, G. W. & Hendrickson, M. J.	Jul. 3–13, 1938		x	
BM 10763–10888	Butters, F. K. & Moore, J. W.	Jul. 1–5, 1939		x	x
BR 4462–4697	Butters, F. K. & Rosendahl, C. O.	Jun. 29–Jul. 8, 1924	x		
BR 6200–6387[6]	Butters, F. K. & Rosendahl, C. O.	Aug. 29–31, 1930		x	x
	Cheney, L. S.[7]	Jun. 20–Jul. 25, 1891		x	
D 1–191	Dahl, A. O.	Jun. 15–22, 1945		x	
L 3605–3724	Lakela, O.	Jul. 4–6; 13, 1940		x	
L 4700–4837	Lakela, O.	Aug. 9; 17, 1941	x		
N 1618–1730	Nielsen, E. L.	Sep. 9–14, 1932		x	x
NBr 3157–3243	Nielsen, E. L. & Breckenridge, W. J.	Jun. 8–9, 1935	x		
OO or OS 982–1155	Gerald B. Ownbey and Findley Ownbey or R. M. Schuster	Aug. 11–20, 1948	x		x
S (S) misc. nos.	R. M. Schuster (and in part, O. M. Schuster)	Misc. dates 1947–48	x		x
	Roberts, T. S.[8]	Jul. 27–Aug. 25, 1879	x		
R 5956–6082[6]	Rosendahl, C. O. (& Rydberg, P. A.)	Aug. 9–17, 1929			x
	Wood, F. F.[7]	Jun. 20–Jul. 25, 1891		x	

[6] On the labels of these specimens the collector is often given as Rosendahl, only.

[7] Cheney and Wood are listed separately because the labels on plants collected on their trip carry only the name of one or the other as collector.

[8] Accompanying Prof. C. W. Hall. The latter made a few collections under his own name.

Note: inadvertently omitted from the above are the following abbreviations:—NE, representing Nielsen & F. Egler (June, 1933); NM, representing Nielsen & J, Moore (Oct., 1935).

11. Place Names in Cook County

In the *Annotated List* which constitutes Section 12, specific collections, in the interests of conserving space, are referred to the nearest *major* geographic feature. These localities are, however, shown only on the most detailed maps. In order that they may be located rather closely on the map of the county presented in Figure I, township and range as well as latitude and longitude are shown on it. The place names in the following list are accordingly identified by township and range.

The place names cited below are primarily those in current usage as represented by Grout and Schwartz (Minn. Geol. Surv. Bull. 24. 1933) U. S. D. A., Forest Service (Map of the Superior National Forest. 1938); Smith and Moyle (Minn. Dept. Cons., Div. Game and Fish, Tech. Bull. 1. 1944); and the general highway maps of the Minnesota Department of Highways. Earlier usages may be sometimes found by referring to Winchell (vol. IV, Final Report, Geol. and Nat. Hist. Survey Minn., pp. 313–345 and 481–521. 1899) and to Upham (Coll. Minn. Hist. Soc. vol. 17. 1920).

Gazetteer

Agnes Lake (T 61 N, R 3 W); Alder Lake (T 64 N, R 1 E); Alpine Lake (T 65 N, R 5 W); Alton Lake (T 62 N, R 5 W); Arrowhead River—see Brule River; Aspen Lake (T 64 N, R 1 W).

Bally Creek (T 61 N, R 1 W); Belle Rose Island (T 63 N, R 7 E); Big Cherry Portage—Moose Lake to Lily Lake; Birch Lake (T 65 N, R 1 & 2 W); Black Point (T 60 N, R 2 W); Brick Island (T 63 N, R 7 E); Brule Lake (T 64 N, R 2 & 3 W); Brule River—on the Gunflint Trail (T 64 N, R 1 E); Brule River—mouth of (T 61 N, R 3 E); Burnt Lake (T 62 N, R 4 W).

Canoe Lake (T 64 N, R 1 E); Caribou Lake (T 65 N, R 1 & 2 E); Carlton Peak (T 59 N, R 4 W); Carribeau River—mouth of—see (?) Poplar River; Cascade River—mouth of (T 60 N, R 2 W); Christine Lake (T 61 N, R 3 W); Clark('s) Bay (T 64 N, R 7 E); Clearwater Lake (T 65 N, R 1 E); Cock Portage—Pigeon River to South Fowl Lake; Cross River (northern) (T 65 N, R 3 & 4 W); Cross River (southern)—mouth of—see Schroeder.

Daniels Lake (T 65 N, R 1 W); Devil's Track Lake (T 62 N, R 1 W); Devil's Track River—mouth of (T 61 N, R 1 E).

East Bearskin Lake (T 64 N, R 1 E); East Pike Lake (T 65 N, R 3 E); East Pope Lake (T 65 N, R 2 W); Elbow Lake (T 62 N, R 1 E).

Fort Charlotte (T 64 N, R 5 E); Fowl Portage—see Cock Portage.

Gaskin Lake (T 64 N, R 2 W); Governor('s) Island—see Susie Island; Grand Marais (T 61 N, R 1 E); Grand Portage (settlement) (T 63 N, R 5 E); Grand Portage Bay (T 63 N, R 5 E); Grand Portage Island (T 63 N, R 5 E); Granite River (T 66 N, R 4 W); Great New Portage—Rove Lake to Rose Lake; Greenwood Lake (T 64 N, R 2 E); Gunflint Lake (T 65 N, R 2 & 3 W); Gunflint Trail—road running north out of Grand Marais.

Hat Point (T 63 N, R 5 E); High Island—see Lucille Island; High Falls (of the Pigeon River) (T 64 N, R 7 E); Horseshoe Lake (T 64 N, R 1 W); Hovland (T 62 N, R 4 E); Hungry Jack Lake (T 64 N, R 1 E).

Jasper Lake (T 65 N, R 5 W); John Lake (T 65 N, R 3 E).

Kadunce Creek—mouth of (T 61 N, R 3 E); Kelso Lake (T 63 N, R 5 W); Kelso Mt. (T 63 N, R 5 W); Kelso River (T 63 N, R 4 W); Kimball Creek—mouth of (T 61 N, R 3 E); Kimball Lake (T 62 N, R 3 E).

Leo Lake (T 64 N, R 1 W); Lily Lake (T 65 N, R 2 E); Lima Mt. (T 64 N, R 1 W); Little Brick Island (T 63 N, R 7 E); Little Caribou Lake (T 65 N, R 1 E); Little Cherry Portage—Lily Lake to Mountain Lake; Little Mississippi (T 62 N, R 2 W); Lize Lake (T 64 N, R 1 W); Long Island (T 63 N, R 7 E); Long Lake (T 62 N, R 3 W); Loon Lake (T 65 N, R 3 W); Lucille Island (T 63 N, R 7 E); Lutsen (T 60 N, R 3 W).

McFarland Lake (T 64 N, R 3 E); Magnet Island—see Belle Rose Island; Mark Creek (T 61 N, R 2 W); Mark's Bay—see Clark's Bay; Martin & Perch Portage—Rose Lake to South Lake; Mineral Center (T 63 N, R 5 E); Moose Lake (T 65 N, R 3 E); Moose Portage—North Fowl Lake to Moose Lake; Morrison's Bay (T 64 N, R 7 E); Moss Lake (T 65 N, R 1 W); Mt. Josephine (T 64 N, R 6 E); Mt. Maud (T 63 N, R 5 E); Mt. Rose (T 63 N, R 6 E); Mountain Lake (T 65 N, R 2 E); Mud Lake—see Rose Lake.

North Lake (T 65 N, R 2 W); North Fowl Lake (T 65 N, R 3 E); Northern Light Lake (T 63 N, R 2 E).

Onion Mt. (T 59 N, R 4 W); Otter Lake (near South Lake) (T 65 N, R 1 W); Otter Lake (T 64 N, R 3 E).

Partridge Falls (T 64 N, R 5 E); Partridge Lake (T 65 N, R 1 W); Perch Portage—see Martin Portage; Pigeon Falls—see High Falls; Pigeon Point (T 64 N, R 7 E); Pigeon River—mouth of (T 64 N, R 7 E); Pike Lake (T 61 N, R 2 W); Pine Lake (T 65 N, R 2 E); Pope Lake (T 65 N, R 2 W); Poplar Lake (T 64 N, R 1 & 2 W); Poplar River—mouth of (T 60 N, R 3 W); Porcupine Island (T 64 N, R 7 E).

Reservation River—mouth of (T 62 N, R 5 E); Rocky Lake (T 64 N, R 1 E); Rose Lake (T 65 N, R 1 W); Rove Lake (T 65 N, R 1 E); Round Lake (T 65 N, R 4 W); Royal Lake and River (T 64 N, R 3 E).

Saganaga Lake (T 66 N, R 4 & 5 W); Sailboat Island (T 63 N, R 7 E); Sawbill Creek (T 62 N, R 4 W); Sawbill Lake (T 62 & 63 N, R 4 W); Schroeder (T 58 N, R 4 W); Sea Gull Lake (T 65 N, R 4 & 5 W); Sea Gull River (T 66 N, R 4 W); South Lake (T 65 N, R 2 W); South Fowl Lake (T 64 N, R 3 E); Split Rock Canyon of the Pigeon River (T 64 N, R 5 E); Stump Lake (T 64 N, R 2 E); Susie Island (T 63 N, R 7 E); Swamp Lake (T 64 N, R 1 W).

Temperance River (T 59 N, R 4 W); The Grand Portage—from Grand Portage to Fort Charlotte; Tofte (T 59 N, R 4 W); Tucker Lake (T 64 N, R 3 W).

Watab (Watap) Lake (T 65 N, R 1 E); Watab Portage—Mountain Lake to Watab Lake; Wauswaugoning Bay (T 64 N, R 6 E); West Bearskin Lake (T 65 N, R 1 W); West Pike Lake (T 65 N, R 2 E); Winchell Lake (T 64 N, R 2 W); Wonder Lake (T 62 N, R 5 W).

12. Annotated List of the Vascular Plants of Cook County[9]

The following conventions have been adopted in this section:

Locality—The place name of the *nearest major* geographical feature only is given in the citations of specimens. This does not always duplicate a place name on the plant label. Details of locality and habitat are omitted for individual collections. The order in which the major geographical localities are listed is first from west to east in the region of the Border Lakes to Pigeon Point, then from east to west for the areas adjacent to Lake Superior. *cf.* Map of Cook County, Figure I, and Gazetteer in Section 11, preceding.

Collector—If a collector has made a collection of appreciable size this is listed in the Table of Section 10; the collector is then referred to by the identifying initials there indicated.

Location of the specimens cited—Unless otherwise indicated, a sheet of each of the specimens cited is deposited in the Herbarium of the University of Minnesota.

Order of arrangement of the plant names—With rare exceptions, this follows the order in Gray's Manual, ed. 8.

Acknowledgements—The writers are deeply indebted to all those who have been cited in the main body of this section for lending their judgement to the clarification of some of the problems in identification that have arisen over the past decade and a half.

In addition the junior author would like to acknowledge his debt to the late Mr. C. A. Weatherby for checking and re-writing the Latin description of *Lycopodium* × *Buttersii*, and to his friend Dr. R. C. Foster of the Gray Herbarium for performing the same service for the balance of the Latin descriptions.

EQUISETACEAE

Equisetum arvense L. (typical). Grand Portage, Be 580.—Shore of Lake Superior.

E. arvense, var. boreale (Bong.) Ledeb. Grand Portage, R 6010.—Shady woods.

E. pratense Ehrh. Grand Portage, Be 581.—Edge of road.

E. sylvaticum L., var. pauciramosum Milde, f. multiramosum

[9] Many of the records indicated as new in this section were made available over the years to Prof. M. L. Fernald while he was preparing the eighth edition of Gray's Manual; therefore many of them have already been published there.

Fernald, Rhodora **20:** 131. Poplar Lake, D 6; Grand Portage, Be 701; Hovland, BR 4624.—Wet woods and roadside ditches; ubiquitous.

E. palustre L. Grand Portage, BM 10878.—Spruce-tamarack swamp. We find that our material has ovate-lanceolate teeth with wide borders, corresponding to Marie-Victorin's illustration (Contrib. Lab. Bot. Univ. Montreal, no. 9: p. 55. 1927) of the European type. Therefore we are not applying to this material his name, var. *americanum*, for the usual North American material.

E. fluviatile L. (typical). Clearwater Lake, SS 6021; Mountain Lake, BB1 441; Poplar Lake, BA (sight record); Belle Rose Island, OS 1063; Long Island, OS 1111.—Lake shores; fairly abundant wherever suitable shallow-water habitats occur, which are not as common as farther south in the state.

E. fluviatile, f. linnaeanum (Döll) Broun, Index to N. A. Ferns, p. 87. 1938. Loon Lake, D 160; Rove Lake, BA 111; Tofte, L 6338; Schroeder, L 6415, SS (6–26–48).—Shallow water of lakes and roadside ditches; local because many lakes of the region are deep right up to the shore.

E. hyemale L., var. affine (Engelm.) A. A. Eaton. Cross River, BA 930; Grand Portage, Be 522.—Old portage trail.

E. variegatum Schleich. Schroeder, SS 12015, OO 994.—"Ditch along roadside."

This is typical, according to Gray's Manual, ed. 8 (p. 9), having sheathes slightly broadened upward and cone but 6 mm. or less long. Also collected by R. M. Schuster (12035a) on dripping ledges, Lower Falls, Gooseberry River in Lake County.

E. scirpoides Michx. Susie Island, OS 1084, OO 1131; Grand Marais, H. L. Lyon 929; Cascade River, D. Bierhorst (Sept. 10–11, 1952).—Mossy bog, Thuja woods; rare.

Interestingly enough this is locally very abundant somewhat further east along the North Shore.

LYCOPODIACEAE

Lycopodium Selago L. (typical). Clearwater Lake, BA 84 (in part, *fide* R. M. Tryon), BA 94a; Pigeon Point, S 6003; Susie Island, OO 1152; Schroeder, OS 983a.—Shaded cliffs and moist slopes.

This phase with the appressed leaves is rare.

L. Selago, var. patens (Beauv.) Desv. *cf.* Wilson, Rhodora **34:** 169–172 and **36:** 13–19. Rove Lake BBsH 111; Clearwater Lake, BBl 466, BA 84, BA 94b; Alder Lake, BsH 384; Mountain Lake, BAA 246, BBsH 29, BBsH 59, BBsH 65; Clark's Bay, BAA 403; Porcupine Island, OO 1057; Belle Rose Island, OO 1067; Lucille Island, BAA 376; Long Island, OS 1115; Grand Portage BR 6296; Schroeder, OS 983b.—Cliffs, moist woods, cedar swamps, talus slopes; fairly frequent especially on talus slopes.

A collection made by R. M. Schuster (s. n., Sept. 4, 1947), as well as part of Butters and Abbe 84, is intermediate between typical *L. Selago* and its var. *patens* according to R. M. Tryon.

L. LUCIDULUM Michx. North Lake, MacMillan Brand & Lyon 136; South Lake, BA 790; Clearwater Lake, BBl 446; Mountain Lake, BBsH 148; Macfarland Lake, BsH 367; Royal Lake, BsH 235, BsH 329; Clark's Bay 6221; Grand Portage, R 6011; Brule River, BR 4533; Devil's Track River, C. W. Hall (Aug. 21, 1879); Carlton Peak, T. S. Roberts (Aug. 25, 1879); Schroeder, OS 983c.—Cliffs, woods, swamps; fairly frequent.

In addition to the spore characters mentioned by Wilson (*loc. cit.*) there are two other categories of rather minute characters which may be found useful in distinguishing *L. Selago* (and its vars.) from *L. lucidulum*. These have the advantage over the spore characters of being applicable to sterile material.

Stomata:—present on both surfaces of the leaf of *L. Selago* (and its vars.), although more abundant on the abaxial surface.
—present only on the abaxial surface in *L. lucidulum.*

This difference is visible under the higher powers of the dissecting microscope, so that it is not necessary to try to dissect off the epidermis.

Scales of propagative bulbils:
—the larger scales are acute or acutish at apex in *L. Selago.*
—they are rounded or obtuse with a slight apiculation in *L. lucidulum.*

L. × Buttersii Abbe[10] hybr. nov.—*L. lucidulum* × *L. Selago*, var. *patens.*—Cliffs; very rare.

Lycopodium × Buttersii occurs, as far as the collections of the Herbarium of the University of Minnesota indicate, only in Lake and Cook counties. The records show that it is often found in association with the putative parents.

The following table summarizes respects in which it is intermediate between *L. lucidulum* and *L. Selago*, var. *patens:*

[10] Rami fertiles 15–35 cm. longi; folia lineari-attenuata vel paullum lineari-oblanceolata, paginis ambobus stomatibus instructa, fere integra vel sparse minuteque denticulata, in gemma adpressa, tum patentia, demum reflexa; zona foliarum breviorum alterna zona foliarum longiorum; bulbilli obtusiusculae (eis parentum mediae); caules fructiferi 1- vel 2-furcati; spori magnitudine figuraque valde variabiles, plerique abortivi. Typus: Butters, Burns & Hendrickson 111a (Herb. Univ. Minn.).

Tall, 15–35 cm. long (fruiting stems); leaves linear-tapering to slightly linear-oblanceolate with stomata on both surfaces, nearly entire but with occasional minute denticulations, appressed in bud, then spreading, and eventually reflexed; a zone of short leaves alternating with a zone of long ones, but not rendering the shoot conspicuously moniliform; bulbils slightly obtuse (about intermediate between those of the parents); fruiting stems once or twice forked; spores very variable in size and shape, many of them abortive.

Minnesota: *Lake County;* in spruce-balsam bog on roadside, Ely-Finland road, Aug. 27, 1937, *F. K. Butters and C. Rosendahl 6881;* mossy cliffside at Baptism River, Aug. 10, 1944, *Olga Lakela 5681; Cook County;* cliff south of outlet of Rove Lake, July 11, 1938, *Butters, Burns and Hendrickson 96;* cliff south of Rove Lake, July 11, 1938, *Butters, Burns and Hendrickson* 111a (TYPE); in deep, moist, swampy coniferous forest in center of Pigeon Point beyond Clark's Bay, Sept. 5, 1947, *R. M. Schuster 6005.*

	L. lucidulum	*L.* × *Buttersii*	*L. Selago* var. *patens*
Shoot	moniliform	slightly moniliform	cylindrical
Leaves			
—shape	linear-oblanceolate	intermediate	linear-tapering
—margins	denticulate	intermediate	entire
—stomata	below only	both surfaces	both surfaces, more below
Bulbils, (large scales)	rounded to obtuse, slightly apiculate	intermediate	acute or acutish

The characters of this hybrid were carefully worked out by Dr. Butters during the period prior to his death; the junior author therefore has taken the liberty of naming it for Dr. Butters.

L. ANNOTINUM L. (typical). Sea Gull Lake, L 3647; Gunflint Lake, SS 6015 (*fide* Tryon); Hungry Jack Lake, BR 6347; Poplar Lake, D 69 (*fide* Tryon); Rove Lake, BBsH 93; Clearwater Lake, BA 95; Royal Lake, BsH 271; Pigeon Point, N 1644, S 6006 (*fide* Tryon); Clark's Bay, BR 6220; Belle Rose Island, BR 6235; Lucille Island, BAA 384; Grand Portage, Be 550, SS 6053 (*fide* Tryon); Brule River, BR 4550; Temperance River, SS 6033 (*fide* Tryon).—Cliffs and woods; very abundant.

L. ANNOTINUM, var. ACRIFOLIUM Fernald, RHODORA **17:** 124. Mountain Lake, BBsH 20; Grand Marais, MacMillan Brand & Lyon 60.—Trails, etc.

R. M. Tryon assigns the above collections to var. *pungens* "tending toward typical."

L. ANNOTINUM, var. PUNGENS (La Pyl.) Desv. Clark's Bay, BR 6248; Lucille Island, BR 6232; Grand Portage, Be 673; Hovland, OS 1006.—Swamps and shore rocks.

L. CLAVATUM L. *sens. lat.* Mineral Center, Be 644; Temperance River, Lakela 5698, SS 6032, OO 997.

R. M. Tryon would assign the collections listed under the following two varieties to typical *L. clavatum.*

L. CLAVATUM, var. LAURENTIANUM Vict. Sawbill Lake, Bg 121; South Lake, BA 809a, BA 809b; Poplar Lake, BR 6368; Clearwater Lake, BBl 447; Lima Mountain, BA 886; Clark's Bay, BR 6222; Belle Rose Island, BR 6236.—Woods.

Included under this variety are collections (BBl 447, BR 6222) which could be referred to Victorin's var. *subremotum.* However this so-called variety is better considered a luxuriant phase of var. *laurentianum*, because both may appear on one and the same plant.

L. CLAVATUM, var. MEGASTACHYON Fernald & Bissell, RHODORA **12:** 53. Sea Gull Lake, BBl 395; Poplar Lake, BR 6369; Hungry Jack Lake, BR 6346; Clearwater Lake, BBl 445, N 1694; Lima Mountain, BA 885.—Woods; abundant.

L. OBSCURUM L. (typical). Mountain Lake, BBsH 132.—Woods; very rare in Minnesota.

An intermediate form with flattened twigs, but mostly without short ventral leaves is represented by the following: Royal Lake, BM 10849; Grand Portage, Be 546; Mineral Center, Be 674. R. M. Tryon assigns these specimens to var. *dendroideum* with "some tendency toward typical."

L. OBSCURUM, var. DENDROIDEUM (Michx.) D. C. Eaton. Sawbill Lake, Bg 120; Poplar Lake, L. W. Orr 5, L. A. Koelnau 113, D 34; Clearwater Lake, BBl 444; East Pike Lake, BsH 214; Pigeon Point, N 1624; Susie Island, R (Aug. 15, 1929), OO 1023; Devil's Track Lake, E. Loula 20; Cascade River, Roberts (no no., no date).—Talus slopes and woods; very abundant in Cook Co.

BBl 444 may be referred to Victorin's f. *exsertum*.

L. COMPLANATUM L. (typical). Sawbill Lake, Bg 119; Poplar Lake, BR (Aug. 25, 1934), D 50d; Birch Lake, D 57; Clearwater Lake, BBl 454; Susie Island, OO 1045; Hovland, SS 6071.—Woods; very rare in the state.

Although the rest of our collections of this species are cited to variety, there is considerable question as to whether the characters are sufficiently strong to justify taxonomic segregation. However, the writers have found no organic connection between plants bearing the characteristics of these varieties although the plants grow intermixed.

R. M. Tryon assigns the specimens cited under the two following varieties to typical.

L. COMPLANATUM, var. CANADENSE Vict. Watab Lake, BA 120a, BBsH 17; Clearwater Lake, BBl 456; Clark's Bay, BR 6252; Susie Island, R 6035c.—Woods.

L. COMPLANATUM, var. ELONGATUM Vict. Poplar Lake, BR (Aug. 25, 1934, rhizome 2 inches deep), BR (Aug. 23, 1934, rhizome 8–10 inches deep); Watab Lake, BBsH 16; Caribou Lake, BsH 398; Mountain Lake, BBsH 26; Grand Marais, H. L. Lyon 929.—Woods; the most abundant of the varieties. Most of the specimens have rather deep-seated rhizomes, but may vary in this respect even in the same plant.

L. TRISTACHYUM Pursh (*cf.* Clausen, Amer. Fern Journ. 35: 9–20). Susie Island, R 6035b.—On rocks.

This is a sterile specimen, but it is almost certainly this species. Specimens from this state previously identified as this species are *L. complanatum*, var. *elongatum*.

SELAGINELLACEAE

SELAGINELLA SELAGINOIDES (L.) Link. Brick Island, OS 1076; Susie Island, S (Sept. 6, 1947), OO 1119; Long Island, AA 508, S (Sept. 5, 1947); Sailboat Island, S 11751 (with *Leiocolea gillmani*); Grand Marais, L. S. Cheney (Jul. 26, 1891).—In moist moss and soil in cracks in rocks; very rare. These are the only collections from Minnesota represented in the Herbarium of the University of Minnesota. It is relatively abundant in similar habitats in the Thunder Bay District of Ontario.

S. RUPESTRIS (L.) Spring. Caribou Lake, BsH 400; Mountain Lake, BAA 255, S (July 11, 1947); John Lake, BM 10790; South Fowl Lake, BsH 319; Clark's Bay, BR 6225, BAA 398; Wauswaugoning Bay, R

6056; Mount Josephine, BR 6310, BA 172, BA 1044, SS 6001; Mt. Rose, SS 6068; Mineral Center, BR 4564.—Dry, exposed rocks on cliffs and hill-tops; general.

ISOËTACEAE

Isoëtes muricata Dur. Gunflint Lake, BR 6384; South Lake, MacMillan Brand & Lyon 146; Poplar Lake, BA 775; Birch Lake, BA 814; Rose Lake, MacMillan Brand & Lyon 170 & 198; Hungry Jack Lake, BR 6353; Rove Lake, MacMillan Brand & Lyon 171; Northern Light Lake, MacMillan Brand & Lyon 71; Mountain Lake, MacMillan Brand & Lyon 177; Brule River, C. B. Reif A3, C. B. Reif A22; Temperance River, C. B. Reif A14.—Same habitats as *I. macrospora;* apparently fairly frequent.

I. macrospora Dur. Partridge Lake, BA 815; Birch Lake, BA 814a; Hungry Jack Lake, MacMillan Brand & Lyon 99; Devil's Track Lake, MacMillan Brand & Lyon (Aug. 28, 1901).—Local in occasional shallows of some lakes and slow streams; apparently infrequent.

OPHIOGLOSSACEAE

Botrychium multifidum (Gmel.) Rupr. Mountain Lake, BBsH 33; Mount Josephine, BR 6325; Grand Marais, MacMillan Brand & Lyon 45.—Dry woods; infrequent. BR 6325 is assigned by R. M. Tryon to *B. multifidum* var. *intermedium.*

B. multifidum, var. intermedium (D. C. Eaton) Farwell. John Lake, BM 10800.—Top of a bluff; apparently very uncommon.

B. Lunaria (L.) Sw. Brule River, L. S. Cheney (Jul. 2, 1891).

B. Lunaria, f. **onondagense** (Underw.) comb. nov. *B. onondagense* Underw. Bull. Torr. Bot. Cl. 30: 47. 1903. Grand Portage, BM 10866; Grand Marais, C. J. Hibbard (Jul. 25, 1902), H. L. Lyon (Aug. 16, 1906).—Moist woods; rare.

During the academic year 1916–17 the senior author, while at the Gray Herbarium, pencilled the following comment on a sheet of this variety collected by Williams, Collins and Fernald, July 8, 1905:—

"This seems to be exactly the same form as to shoot which Underwood described as *B. onondagense* from the vicinity of Syracuse, N. Y. It appears to be merely a shade form of *B. Lunaria.* Similar leaflets occur also in material from British Columbia, and also in Swiss material (*vide* A. S. Pease, no. 9274, Schya Pass).

The short root axis which is described for *B. onondagense* is often found in *B. Lunaria* from various sources.

F. K. B."

There seems to be no good reason to change this viewpoint and we therefore suggest that it be treated as a form. The combination is commonly attributed to Clute (Our Ferns, pp. 76 and 384, 1938) but it has not been made in a valid fashion.

B. simplex E. Hitchc. *sens. lat.* Lima Mountain, BA 862½; Temperance River, R. M. Schuster A5409.—"Moist, springy side of marly ditch

along road." BA 862½ was detected by R. M. Tryon in a collection of *B. matricariaefolium* and was assigned by him to *B. simplex*, var. *laxifolium* Clausen.

B. MATRICARIAEFOLIUM A. Braun. Lima Mountain, BA 862; Temperance River, SS 6041.—Moist woods; rare.

B. VIRGINIANUM (L.) Sw., *sens. lat.* Sea Gull Lake, L 3627; Wauswaugoning Bay, NE 2325 (too young for identification as to variety).—Shady woods.

B. VIRGINIANUM (typical) *cf.* Butters, RHODORA **19:** 207. John Lake, BsH 268; Mount Josephine, BA 1052; Schroeder, BA 1060.—Wet woods; scattered and infrequent. BsH 268 is considered transitional to var. *europaeum* by R. M. Tryon.

B. VIRGINIANUM, var. INTERMEDIUM Butters, RHODORA **19:** 210. Clearwater Lake, BA 67; Mountain Lake, BAA 301, BBsH 151; East Pike Lake, BsH 208a; Royal Lake, BM 10855; Pigeon River, BR 4615; Grand Portage, BM 10880; Mount Josephine, BA 181; Mineral Center, BR 4593.—Moist woods; occasional. BA 181, BAA 301, BBsH 151, BsH 208a, BM 10880, BM 10855 are assigned by R. M. Tryon to typical *B. virginianum.*

B. VIRGINIANUM, var. EUROPAEUM Ångstr. Gunflint Lake, R 5455; West Pike Lake, BsH 206; Grand Portage, R 6291; Grand Marais, H. L. Lyon 934.—Moist woods; occasional.

OSMUNDACEAE

OSMUNDA REGALIS L., var. SPECTABILIS (Willd.) A. Gray. Sea Gull Lake, N 1732, L 3605; Cross River, BBl 394; Horseshoe Lake, BA 131; Royal River, BsH 343; Brule River, BR 4537; Devil's Track River, T. S. Roberts (Aug. 18, 1879).—Lake shores, river margins, dank woods, rarely in shallow water; occasional. BA 131 is unique in that the whole colony from which this collection was made was growing in several inches of water.

O. CLAYTONIANA L. Watab Lake, BAA 319; Royal River, BsH 364.—Moist woods; fairly abundant (more so than the number of collections indicates).

O. CINNAMOMEA L. Between Birch and Poplar Lakes, BA 820.—Sphagnum swamp; infrequent.

POLYPODIACEAE

WOODSIA ILVENSIS (L.) R. Br. Lake Saganaga, N. L. Huff (Aug. 23, 1941); Moss Lake, D 139; Winchell Lake, BA 140a; Watab Lake, BAA 244b; Clearwater Lake, BBl 461, BA 56, BA 213, D 115; Little Caribou Lake, BsH 426; Mountain Lake, BAA 275; MacFarland Lake, BBl 330; Royal Lake, BsH 236; Pigeon Point, N 1632, BA 1001; Porcupine Island, AA 583; Susie Island, B (Sept. 1, 1927), AA 565, OO 1044; Lucille Island, BR 6233, N 1657; Sailboat Island, OO 1101; Grand Portage, R (Aug. 14, 1929), BR 621, BA 154, SS 6057, SS 6058; Grand Portage Island, R 6027; Mount Josephine, BR 6309; Kimball Creek, R 2608; Grand Marais, R

(Aug. 9, 1927); Carribeau River, BR 4494; Temperance River, L 4790; Thunder Bay Dist., Ont. (Pigeon Bay), AA 609, AA 609a.—Ubiquitous on eruptive and metamorphic rocks; along with *Polypodium virginianum* the most abundant fern of the region.

The collections listed above vary widely in the amount of chaffiness. The typically chaffy plants (for instance, BA 56, BsH 426, AA 583, BR 6233, AA 609) are the most common throughout the region. Rarely a collection (BAA 275) will range from extremely chaffy to relatively glabrous. There are relatively glabrous phases, approaching *W. alpina* (for instance, BA 140a, BBl 461, BR 4494, AA 609a) which are considerably less frequent than the typically chaffy phase. It may well be that this relatively glabrous phase is a naturally occurring backcross of *W.* × *gracilis* to *W. ilvensis* (*cf.* remarks below under *W.* × *gracilis*). This relatively glabrous phase may also be interpreted as ecological. Whether either or both interpretations may be correct can be determined only by actual experiment with a group of ferns which are apparently difficult to grow in cultivation.

W. ALPINA (Bolt.) S. F. Gray (typical) *W. Belli* (Lawson) A. E. Porsild, RHODORA **47:** 147. 1945. Clearwater Lake, BBl 397, BBl 458, BBl 459, BA 96, BBsH 5, SS 6018; Mountain Lake, BBsH 126a; Pigeon Point, BA 998; Devil's Track River, BR 4641; Poplar River, BR 4697; Temperance River, L 4789, SS 6040.—Damp shady cliffs and canyons; very rare. Local and extremely scarce; apparently restricted to regions of basic rock.

The above-mentioned specimens are typical, and except for collections made at the Gooseberry River and Manitou River in adjacent Lake County, are the only records for the state as represented in the Herbarium of the University of Minnesota.

W. × GRACILIS (Lawson) Butters, Amer. Fern Jour. **31:** 15. (*W. alpina* × *W. ilvensis*) *W. ilvensis*, var. *gracilis* Lawson. Watab Lake, BAA 244a, BBl 397a, BBsH 5a; Mountain Lake, BAA 275, BBsH 126; Pigeon Point, AA 591, BA 999; Grand Portage, BA 153, BM 10884.—Cliffs; local.

For a more general discussion, see Butters (*loc. cit.*). Several of the above were found in intimate association with the presumed parents. At any one station there are usually more plants of the hybrid than of *W. alpina*.

This hybrid is prevailingly sterile, but occasional sporangia will mature and then contain spores which are usually malformed. It is conceivable that occasional spores may be viable. In this case there occurs the possibility of a backcross to the very common *W. ilvensis*. The least chaffy specimens referred to under *W. ilvensis* may possibly have this origin; they are, however, normally fertile. R. M. Tryon has annotated BM 10884 and BAA 275 as "*Woodsia ilvensis* (L.) R. Br."

W. GLABELLA R. Br. Pigeon Point, AA 589, BA 1002; Grand Portage, B (Sept. 14, 1929), BR 6207, BBl 365, BA 152, SS 6055.—Moist, slate cliffs; extremely local and rare. The old reference in Upham (Geol. Nat. Hist. Surv. Minn., Ann. Rept. 1883, Pt. VI) to a station for this species

at Stillwater in southeastern Minnesota is spurious, being based on a sterile specimen of that ubiquitous ferny weed *Cystopteris fragilis*. It is otherwise represented from Minnesota only by R. M. and O. M. Schuster 6076 collected on rock outcrops, Gooseberry River in Lake County.

W. CATHCARTIANA B. L. Robinson, RHODORA **10:** 30. John Lake, BM 10787, BM 10793, BM 10795; Grand Portage, R 6064a, Butters & Wherry (June 29, 1935), BA 151.—Moist slate talus below cliffs; local, but abundant at a few stations.

W. × ABBEAE Butters, Amer. Fern Jour. **31:** 18. *W. Cathcartiana* × *W. ilvensis*. John Lake, BM 10785; Grand Portage, BBs 713½; Thunder Bay District, Ont. (Pigeon Bay), AA 596.—Cliffs; rare. This is discussed in more detail in Butters (*loc. cit.*).

W. SCOPULINA D. C. Eaton. Rove Lake, BBsH 109; Clearwater Lake, BBl 418, BBl 455, Butters & Wherry (June 29, 1935), BA 123, Butters & Abbe (June 21, 1936); Alder Lake, BsH 389; Mountain Lake, BAA 278, BAA 281, BBsH 85, BBsH 119, BBsH 137; West Pike Lake, BsH 164, BsH 180; East Pike Lake, BsH 231; MacFarland Lake, BsH 370; North Fowl Lake, BABs 654; South Fowl Lake, BsH 311, BM 10830; Royal Lake, BsH 255, BsH 341, BsH 355, BM 10847; Pigeon Point, BA 1000, BA 1005; Grand Portage, R 6064b, BR 6209, BR 6218, BBl 418, Butters & Wherry (June 30, 1935), BA 148, B (Jul. 14, 1937), SS 6054; Mount Rose, S 6002; Thunder Bay Dist., Ont. (Pigeon Bay), AA 610.—Moist cliffs; throughout the Rove Slate region, extremely localized—very abundant on some cliffs, rare on others, and absent from many.

The collections cited above fill in another gap in the east-west distribution of a species notably disjunct in the eastern portion of its geographic area.

CYSTOPTERIS FRAGILIS (L.) Bernh. (typical). *cf.* Weatherby, RHODORA **37:** 375. Moss Lake, D 147; Clearwater Lake, BBl 464, BA 53, BA 120, BsH 164a; Mountain Lake, BBsH 51, BBsH 53; East Pike Lake, BsH 220; John Lake, BM 10794; MacFarland Lake, BBl 332; Royal Lake, BsH 244, BsH 330; Pigeon Point, BA 1006; Grand Portage, R 6027a, B (Sept. 14, 1929), BR 6210; Brule River, BR 4546, BR 4547, BR 4548; Carribeau River, BR 4501; Poplar River, BR 4697a.—Moist cliffs, etc.; ubiquitous.

C. FRAGILIS, var. LAURENTIANA Weatherby, RHODORA **28:** 130. Cascade River, T. S. Roberts (Aug. 2, 1879).—Apparently very rare.

C. FRAGILIS, var. MACKAYII Lawson. Clearwater Lake, D 114; Mountain Lake, BBsH 121; Royal Lake, BM 10845.—Moist cliffs; rare.

R. M. Tryon has annotated BM 10845 and BBsH 121 as intermediate between *Cystopteris fragilis* (typical) and var. *Mackayii*.

PTERETIS PENSYLVANICA (Willd.) Fern. (typical). West Pike Lake, BsH 189.—Moist woods, often along small streams; common.

P. PENSYLVANICA, f. PUBESCENS (Terry) Fern., RHODORA **47:** 124. Mountain Lake, BBsH 149; Grand Portage, BR 6334; Mineral Center, BA 195; Kimball Creek, BR 4667.—Moist woods; common.

ONOCLEA SENSIBILIS L. Cross River, BBl 393; Hungry Jack Lake, BAA 333; Leo Lake, BR 6333; Mountain Lake, BBsH 150; Lucille

Island, BAA 369.—Low, wet woods and along roadsides; local, usually in obviously warm pockets—much more abundant further south in the state.

Dryopteris disjuncta (Ledeb.) C. V. Morton, Rhodora **43:** 217. *D. Linnaeana* C. Chr. Sea Gull Lake, L 3626; Sawbill Lake, Bg 124; Poplar Lake, L. W. Orr 7, L. W. Orr 22, D 90; Watab Lake, BA 108a; Royal Lake, BsH 238; Grand Portage, Be 575; Porcupine Island, OO 1054; Susie Island, OO 1124; Grand Marais, T. S. Roberts (Jul. 31, 1879), H. W. Slack (July 1892).—Moist woods; frequent.

D. Robertiana (Hoffm.) C. Chr. Cross River, BA 900; North Lake, D. Lange 15; Poplar Lake, BA 845; Watab Lake, BAA 226, BAA 244; Clearwater Lake, BBl 460, BA 95a; Little Caribou Lake, BsH 428, BsH 429; Mountain Lake, BAA 280, BBsH 30, BBsH 125; John Lake, BM 10816; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 686.—Moist wooded cliffs; frequent.

D. Phegopteris (L.) C. Chr. Gunflint Lake, BBl 374; Rove Lake, BA 107a; West Pike Lake, BsH 203; MacFarland Lake, BBl 340, BBl 343; Pigeon Point, BAA 431; Grand Portage, R 5997; Grand Marais, T. S. Roberts (Jul. 31, 1879); Tofte, R 7831.—Moist woods; frequent.

D. spinulosa (O. F. Muell.) Watt (typical). Gunflint Lake, BBl 376; Poplar Lake, L. W. Orr 8, BA 821; Rove Lake, BBl 425; Mountain Lake, BBsH 32; South Fowl Lake, BABs 629; Pigeon River, BR 4616; Grand Portage, R 6071, BR 6288; Hovland, BR 4631; Tofte, R 7849.—Swampy woods; frequent.

D. spinulosa, var. fructuosa (Gilbert) Trudell. Lucille Island, BR 6231; Grand Portage, BR 6284, BR 6285.—Swampy woods; rare. These are the only collections from Minnesota of this western and Eurasian phase. It has dark scales and obliquely ascending rhizomes. Its fronds, in our experience, may sometimes be as much as a meter in length.

D. spinulosa, var. intermedia (Muhl.) Underw. Grand Marais (10 mi. north), BA 768; Morrison Bay, BBs 714; Grand Portage, BR 6282, BR 6286, BR 6287, BR 6290; Mineral Center, BA 196.—Moist deciduous and balsam woods; infrequent. BR 6286 and 6290 combine in varying degrees the characteristics of the typical material and var. *intermedia* with respect to:—location of new growth, angle of the rhizome, glandulosity of the indusia, and size and sculpturing of the spores.

D. spinulosa, var. americana (Fisch.) Fernald, Rhodora **17:** 48. Poplar Lake, L. W. Orr 20; Mountain Lake, BAA 282; Pigeon Point, Rosendahl and Rydberg 6081; Clark's Bay, N 1621; Morrison Bay, Rosendahl and Rydberg 6051; Grand Portage, J. M. Holzinger (Aug. 11 and 12, 1902), Rosendahl and Rydberg 5984, Rosendahl and Rydberg 5991, Rosendahl and Rydberg 6033a, B (Sept. 14, 1929), BR 6283; Mineral Center, BA 197; Hovland, BR 4632.—Swampy woods; frequent. Often growing with the preceding.

D. cristata (L.) A. Gray. Sawbill Lake, Bg 123; Cross River, BA 897; Lima Mountain, BA 854; Mountain Lake, BBsH 145.—Tamarack and alder swamps; locally abundant, suitable habitats infrequent.

D. fragrans (L.) Schott, var. remotiuscula Komarov. Saganaga Lake, N. L. Huff (Aug. 23, 1941); Sea Gull Lake, L 3697; Gunflint Lake,

BBl 378; North Lake, D. Lange 16; Poplar Lake, R 5434, D 89, D 97; Watab Lake, BAA 245; Clearwater Lake, Butters & Wherry (1935), BA 57, BA 214; Little Caribou Lake, BsH 430; Mountain Lake, BAA 275; MacFarland Lake, BBl 331; Pigeon River, L. S. Cheney (Jul. 6, 1891), BR 4622; Pigeon Point, BAA 432; Belle Rose Island, BR 6240, OO 1059; Susie Island, BBl 371; Lucille Island, N 1658, BAA 379; Grand Portage, R 6067, BR 6208, R 7866, SS 6059; Hovland, SS 6073; Brule River, BR 4542.—Rocks and cliffs; abundant.

ATHYRIUM ANGUSTUM (Willd.) Presl, *sens. lat.* *A. Filix-femina* (L.) Roth, var. *Michauxii* (Spreng.) Farw. Clearwater Lake, BBl 448, BBl 449; Grand Portage, R 7888; Porcupine Island, AA 581, BBs 746; Sailboat Island, OO 1100; Carribeau River, BR 4500; Tofte, R 7830.

Very commonly plants from the cold shore of Lake Superior, or places where the soil is limited, do not develop well and therefore cannot be determined to variety.

A. ANGUSTUM, f. TYPICUM Butters, RHODORA **19:** 191. Pigeon Point N 1643; Porcupine Island, BR 6255; Long Island, AA 549; Grand Marais, T. S. Roberts (Aug. 14, 1879).—Rocks along the shore of Lake Superior and more or less throughout Cook County.

A. ANGUSTUM, var. ELATIUS (Link) Butters, RHODORA **19:** 191. *A. Filix-femina*, var. *Michauxii*, f. *elatius* (Link) Clute. Grand Portage, Be 514.—Everywhere in moist places in woods; very abundant.

Intermediate between f. *typicum* and var. *elatius*, is a collection from Grand Marais (T. S. Roberts, July 31, 1879).

A. ANGUSTUM, var. RUBELLUM (Gilbert) Butters, RHODORA **19:** 193. *A. Filix-femina*, var. *Michauxii*, f. *rubellum* (Gilbert) Farw. Sawbill Lake, Bg 122; Greenwood Lake, E. Loula 24; Lucille Island, N 1656; Devil's Track River, BR 4640; Grand Marais, R 5957.—Crevices in shore rocks and in wet places in forest; less abundant than the preceding varieties.

ASPLENIUM TRICHOMANES L. Mountain Lake, BBsH 136; East Pike Lake, BsH 228; John Lake, BM 10798; Royal Lake, BsH 250, BsH 333.—Moist, east-facing cliffs; very local, but abundant and luxuriant where it occurs.

Previously known in Minnesota, according to records in the Herbarium of the University of Minnesota, by the one collection from Vasa, Goodhue County (s. e. Minn.) made by N. L. T. Nelson in 1894, but it has not been found recently in that region of dolomites and sandstones. It is reported from Taylor's Falls (Miss Cathcart) and from Lake City (Mrs. Ray) by Upham (Geol. Nat. Hist. Surv. Minn., Ann. Rept. 1883, pt. VI). It is apparently limited to the extreme eastern edge of the state, in spite of Upham's comment that it occurs "throughout the state." The species has a curious distribution, occurring in many states to the east and south and in Manitoba, but not to the west until the coast is reached.

There seems to be no appreciable difference between American and European specimens, except that the walls of the cells in the scales are perhaps a little more yellow in the European plants. According to Gray's

Manual (ed. 8) the fronds are said to vary from 0.8 to 2.2 dm. in length—in our material they range from 0.4 to 2.5 dm. Pinnae may be up to 8 mm. in length, while the smallest are 2 mm. in length (in the central part of the frond).

Cryptogramma Stelleri (S. G. Gmel.) Prantl. Royal Lake, BM 10859; Pigeon Point, BA 997; Grand Portage, B (Sept. 14, 1929) BR 6206, BBl 364, BA 150, SS 6056, R 7873; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 707.—Moist slate cliffs; rare and local. This species also occurs in the southern part of the state, and there also it is restricted to calcareous rocks. It is one of the strictest calciphiles that we have among ferns.

Pteridium aquilinum (L.) Kuhn, var. latiusculum (Desv.) Underw. ex Heller *cf.* Tryon, Rhodora **43:** 41. Rove Lake, BA (June 23, 1936).—Moderately dry woods; ubiquitous.

Polypodium virginianum L. Birch Lake, D 71; Poplar Lake, D 15, D 98, D 106; Rove Lake, BBsH 94; Clearwater Lake, BBl 470; Little Caribou Lake, BsH 427; Mountain Lake, BAA 240; Pigeon Point, R 6079, N 1634; Susie Island, B (Sept. 2, 1927); Grand Portage, R 6068, Be 629, BA 155; Mineral Center, BR 4563; Grand Marais, T. S. Roberts (Jul. 28, 1879); Temperance River, L 4788.—Extremely abundant especially on large talus blocks at the foot of cliffs throughout the region. The number of collections of this ubiquitous fern gives no indication of its great abundance. The rhizomes are usually in moss and *Cladonia*, very little soil being present. It grows to great size in these habitats, a number of the specimens collected having fronds up to 37 cm. long.

Some of the very large specimens seem to have the sori less marginal than is common with *P. virginianum*, but the appearance of rhizomes and of the scales, and the taste of the rootstocks, all identify it with this species. There is no indication of the occurrence in Cook County of any of the western varieties of *P. vulgare*.

TAXACEAE

Taxus canadensis Marsh. Lake Saganaga, N 1673; Gunflint Lake, BR (Aug. 1934); Partridge Lake, BA 816; Poplar Lake, D 25; Winchell Lake, BA 139; Clearwater Lake, BA 88; Mountain Lake, BAA 273; MacFarland Lake, BBl 336; Pigeon Point, N 1625; Susie Island, OO 1128; Lucille Island, BR 6234; Mineral Center, Be 677; Kimball Creek, R 2622.—Moist woods, talus slopes, shore rocks; rather local.

PINACEAE

Abies balsamea (L.) Mill. Sea Gull Lake, L 3631; Belle Rose Island, OO 1061; Lucille Island, BAA 377; Grand Portage, Be 642.—Abundant throughout the region in all sorts of habitats.

Picea glauca (Moench) Voss. *P. canadensis* (Mill.) BSP. Poplar Lake, BA 833.—Abundant.

P. mariana (Mill.) BSP. Poplar Lake, BA 842; Porcupine Island, BBs 743; Lucille Island, BAA 378.—Abundant throughout the region, not restricted to swamps.

LARIX LARICINA (DuRoi) Koch. Otter Lake, BA 794; Belle Rose Island, OO 1069; Sailboat Island, OO 1099; Grand Portage, Be 613.—Rather infrequent in much of the county, possibly as a result of a severe infestation with a bud-worm some years ago. It is much more frequent in the granite country between Gunflint Lake and Lake Saganaga, where it occurs in quite extensive swamps, sometimes with but little spruce. It is, however, not confined to swamps as is almost always the case farther south in the state.

PINUS STROBUS L. Lima Mountain, BA 871; Sailboat Island, AA 555.—Abundant (and formerly much more so) throughout the region in appropriate locations.

P. RESINOSA Ait. Clearwater Lake, BA 65; Sailboat Island, AA 556; Grand Portage, BR 6320.—Rather scarce throughout the region—less frequent in Cook Co. than elsewhere in the state, and in Cook Co. occurs primarily on well-drained morainic soils.

P. BANKSIANA Lam. Sailboat Island, AA 554.—Very abundant in central part of the county and in granitic area toward Lake Saganaga; and less frequent elsewhere in the county. Mostly on dry sterile soils.

THUJA OCCIDENTALIS L. Birch Lake, BA 800; Clearwater Lake, BBl 473, N 1712; Grand Portage, Be 490, BR 6312.—Often in moderately dry locations, not being confined to swamps by any means; common throughout the region.

JUNIPERUS COMMUNIS L., var. DEPRESSA Pursh. Sea Gull Lake, L 3632; West Bearskin Lake, D 143; Rove Lake, BBl 428; Clearwater Lake, BA 66; Mountain Lake, BAA 225; Pigeon Point, N 1629, BAA 423; Clark's Bay, NBr 3243; Susie Island, R 6040; Lucille Island, BAA 352; Sailboat Island, AA 553; Grand Portage, R 6028a; Mount Josephine, BR 6319 & 6327, BA 188; Onion Mountain, D. M. Stewart (sight record).—On talus slopes, rock ledges and exposed rock surfaces; abundant throughout the region. A few collections from near the immediate shores of Lake Superior approach var. *saxatilis* Pallas (var. *montana* Ait.), although this may be after all merely an ecological form.

J. HORIZONTALIS Moench. Pigeon Point, BAA 434; Clark's Bay, S 6004; Little Brick Island, AA 564; Long Island, AA 512.—Rocky shores of Lake Superior; although this species is fairly general elsewhere in the state, mostly on sand, it was observed in Cook County only on the lake shore.

(*To be continued*)

TWO NEW VARIATIONS IN TRILLIUM.[1]—The specimens cited below are preserved in the herbarium of the Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada (DAO).

TRILLIUM CERNUUM L. var. **terrae-novae** var. n. Pedunculus

[1] Contribution No. 1196. Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada.

pendens 2–5 cm. Flos pendens. Sepala lanceolata, 2.0–2.5 cm long.; petala lanceolata, 2.0–2.5 cm long., 6–8 mm lat., alba, ad marginem viridula. Antherae 5–6 mm, purpureo-roseae.

Newfoundland: *I. J. Bassett 293*, west coast, near Stephenville, west side of E. Harmon Air Force Base, in wet black soil under alder brushes, June 9, 1949 (DAO, type); *I. J. Bassett 269*, eodem, June 4, 1949 (DAO); *Smith, Smith & Squires 346*, Bonavista North, "The Beaches," Brown's Beach, rich woods near beach, July 26, 1946 (DAO).

TRILLIUM ERECTUM L. f. **sessiloides** f. n. Flore sessili.

Ontario, Carleton: Beechwood, close to the cemetery gate, May 1899 (DAO, type).—Bernard Boivin, Department of Agriculture, Ottawa, Canada.

THE REPOPULATION OF INTERTIDAL TRANSECTS[1]

Elizabeth M. Fahey[2]

When bare transects are exposed in the intertidal area, populations occupy them (Fahey & Doty, 1949) until after a time they look like the surrounding "control" areas. In quest of information concerning the actual sequence leading to "climax" associations a detailed study was undertaken at Nobska Point and Woods Hole, Massachusetts. The work was initiated in July, 1947, and is still incomplete. However, since the investigation has been carried on continuously from that time it is hoped that these observations may prove of interest to the marine ecologist and be of value to future workers in the field.

A review of the literature concerning intertidal ecology presents the field worker with many enigmatic ecological problems. In comparison to the extensive publications available there are but few inferences. Lack of such logical conclusions from given data, due to short-term experimentation or for other reasons, has resulted in confusion and in many cases, for example in the matter of biotic succession, this lack has given rise to more than one school of thought. In an effort to understand better what does happen in the intertidal region and why, a long-term program of repopulation studies was outlined. It was planned to clear summer, fall, winter and spring transects in order to test the hypothesis that the first macroscopic forms to appear are

[1] This report has been taken in part from a dissertation which the author submitted to the Department of Biology of Boston University in May, 1950, in partial fulfillment of the requirements for the degree of Master of Arts.

[2] State Teachers College, Bridgewater, Massachusetts.

similar, regardless of what time of the year the strip is cleared, the assumption being that the season of the year in which the transect is denuded has little effect on the cycle of reestablishment. The data recorded could then be applied to determine whether biotic succession occurs in marine associations as suggested in the conclusions of Hewatt (1937), Kitching (1937), Moore (1939), Moore & Sproston (1940) and Scheer (1945) or merely seasonal periodicity as expounded by Shelford (1930), Pieron & Huang (1925) and McDougall (1943). It was also proposed to choose stations in different positions in relation to the movement and force of the sea to observe effects on subsequent colonization. For this reason more than one transect was denuded at each time of denuding. According to the plan, observations were to be made bi-weekly throughout the year or until a complete cycle was reached and all data were to be carefully recorded.

Nobska Point, Cape Cod, Massachusetts was chosen as the site of the experiments and the region was surveyed and photographed in what was thought to be a "climax" condition. The region was then divided into transects (stations) which were designated as IA, IB, IIA, IIB, etc., and a program relative to their denudation set up. Each station was photographed before and after denuding and at low tide periods during the investigation, weather and light conditions permitting. No attempt was made to record horizontal distribution of the various associations noted. The transects were examined from the highest levels in which marine organisms were manifest to the lowest tide levels, and the vertical distribution of all macroscopic forms recorded. The vertical range was noted in centimeters above or below the mean low water datum point (the 0.0 level of tide books). Collections were taken nearly every time observations were made and identification of these herbarium materials was later carried out in the laboratory.

At Nobska Point the unusually low temperatures during the winter of 1947–48 (extremes for this section of Cape Cod) resulted in a complete ice covering over the intertidal area. This provided an excellent opportunity to witness the remarkably destructive effect of ice on the intertidal biota as well as the subsequent repopulation of the areas so denuded. All transects

cleared previously took on at this time the appearance of their immediate surroundings and were lost to view. The intertidal region was then considered to be a series of winter transects scoured of their biota by ice. The subsequent course of repopulation on all transects was similar and the same as that of the surrounding area; so observations after February 21, 1948, were largely confined to one station.

Observations over the six years this investigation has been carried on, tend to support the idea that the problem of classifying the colonizers of denuded transects in the intertidal region as undertaken by Bokenham (1938) and modified by Northcraft (1948) is really a problem of succession. Also, that the course of repopulation, insofar as it concerns any particular succession of species, is dependent on the life cycles and forms of the organisms, as well as the time of clearing in respect to the time of reproduction, particularly of the rapidly-growing longer-lived organisms. Therefore, a classification of the species, from the point of view of their succession in repopulating denuded areas, should include a consideration of growth rate, life cycles and forms and time of reproduction of the species. At Nobska Point the colonizing marine flora and fauna apparently follows a definite order. The first macroscopic forms to appear, i. e., the pioneer colonizers, seemingly vary as to species with the tides and seasons. The "pioneers" are always rapidly-growing forms. They may settle as spores or larvae either over a broad vertical area and then become more narrowly delimited or more rarely they may settle over a restricted range and spread outward. This group may be either transient forms, such as *Enteromorpha*, or persistent forms, such as *Balanus*. Next appear secondary forms which may likewise be of two types: 1) those that are a normal part of the seasonal progression for the area, and 2) those that appear after the pioneers, but which do not persist and which otherwise would not be expected to appear as dominants. Possibly among these latter are the principal "occasional algae" of other workers. Finally, as long as the environment remains uniform or changes cyclically the organisms making up the "climax" situation produce a condition characterized by a certain seasonal progression of forms or by dominants that as species, or communities, seem to reproduce or, at least, maintain

themselves. These latter climax colonizers are slowly-growing or long-lived forms either as species or as individuals.

Recolonization of the transects at Nobska Point compares well with the findings of other investigators. Transects, cleared during the summer and fall, followed a similar sequence during the course of the reestablishment of their biota. The first macroscopic organisms to occur, in all cases, were *Enteromorpha* and *Polysiphonia*. On all rocks sufficiently high, *Calothrix* was an early repopulant.

Some macroscopic forms apparently require a surface unoccupied by other species in order to achieve dominance. One of these is *Balanus* which settled in its second year only within its adult range and on areas free from all algae and older *Balanus*. That is, it was observed in places where old *Balanus* had been worn away by some environmental factor and was observed filling in the spaces between the widely scattered white *Balanus* of the previous year. Bokenham (1938) also mentions this preference of the various species for algae-free rocks. *Enteromorpha* behaved this way in part, for while on one transect it became a dominant form it appeared less so or merely appeared as scattered tufts on the adjacent *Balanus-Ralfsia* settled surfaces. It may very well be that many of the "occasional algae" of Northcraft and of Bokenham are of a similar nature, and likewise might become dominant as pioneers under some circumstances.

On the winter transects *Balanus* was the only macroscopic pioneer below the *Calothrix* zone. *Enteromorpha* failed to appear on the ice-scoured surfaces until more than two months after the *Balanus* has settled. In this case, *Enteromorpha* was not a pioneer even when only the algae are considered. The first macroscopically visible algae which appeared as a coating on the rocks and barnacles were brown algae such as *Chordaria* and *Scytosiphon*. This phenomenon may be taken as evidence that at some seasons certain components (here perhaps *Balanus*) of the complement of forms, expected as pioneers and reproducing at the time, may in some way prevent a form (here *Enteromorpha* which is often a conspicuous colonizer otherwise) from appearing in its usual role. It is possible that the reproductive bodies or juvenile forms were consumed as food by the barnacles.

As one analyzes these recolonization studies many avenues for future investigation and the tremendous amount of experimentation to be done in the field become evident. Because of the difficulties of distinguishing between tidal effects (primary and secondary factors and their chance coincidence), seasonal effects, and the differences between one season and the next (or other) seasons (or cycles, annual or otherwise) a supplementary experiment was felt necessary if biotic succession and seasonal periodicity were to be segregated satisfactorily. It has already been observed that marine organisms in repopulating denuded transects follow a certain course of events leading to the reestablishment of the original pattern of populations. The series of populations has features in common with natural phenomena of the areas already populated (control areas) and features that are unique. Observations tend to support the hypotheses that when tidal variations and seasonal periodicity are eliminated or controlled, biotic succession, when present, can be seen and that the effects of tidal action can be determined by exposing a set of transects to the tides and another to all the same features save the tides.

To test these hypotheses panels were planned for exposure. Eighty pine panels were made up alike in stock and dimensions. A piece of lead was tied to one end and plastic rope to the other end of each panel floated. This immersed the panels in an upright position with about 14 centimeters of the roped end out of water. The panels were numbered and the rope was secured to a wharf so that the panels would neither entangle nor float away. Stationary panels under the same conditions, operationally, were set out. Fisheries Wharf, Woods Hole, Massachusetts was chosen as the site of the experiments. The proximity of the Marine Biological Laboratory facilitated observation and experimentation during both the summer and winter months and offered many other advantages.

Since August 1951 panels have been exposed for overlapping periods of more than two weeks. This controls variation due to periodic fruiting of organisms on non-floating substrata or rhythmically fruiting forms which will provide the reproducing bodies that will initiate growth on these panels. Such panels kept out for a year should show a change in population through the year. If only seasonal periodicity is involved each of the

population changes observed should be of organisms capable of pioneering and should be independent of previous populations. This experiment has been outlined to run for a two year period and observations and collections are currently being made weekly. Since panels are to be exposed for one, two, three, four, six, seven, twelve and twenty-four month periods, they are set out in varying numbers monthly. When removed panels are floated in a tray, examined, photographed and all data carefully recorded. Notes on the dominant species occupying non-experimental nearby areas (pilings, wharf and wall) are taken.

The experiment was designed to run for a year but subsequent observations and complexities indicated this to be too short a time interval and it was deemed wise to continue it through a second year. At the present time the results for eighteen months have been recorded. These results indicate that biotic successions can be demonstrated in the intertidal regions of Woods Hole, Massachusetts, and these may correspond closely to those already noted by Scheer (1935) working at Newport Harbor, California. Redfield & Deevy (1952) have suggested a possible significance in the fact that a high proportion of the evidence for biotic succession comes from the Pacific Coast of North America where seasonal phenomena are less pronounced than elsewhere in the temperate zone. They conclude with the statement, "Where seasonal variations are large, biotic succession may not be obvious." On the basis of my studies I believe that biotic succession is obvious enough where seasonal variations are large but few workers make the necessary long-term observations in a region with the rigorous climatic conditions found in the New England winter.

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Color Form of Helianthus mollis.—Throughout its range ordinary *Helianthus mollis* has deep-yellow or orange-yellow rays and disk flowers. During the summer of 1950 I observed a pale-colored variant of this species growing in a prairie along a railroad in northern Missouri. Unlike the typical color form, the pale variant had the disk pale yellow with the disk flowers yellow-green or pale yellow. The pale yellow rays were shorter than those of ordinary *H. mollis.* Two colonies of the pale-colored form were found in the midst of the ordinary deeper yellow colored phase.

Two plants were transplanted to my wild flower garden in northern Illinois. These were studied during 1951 and the characters of the pale yellow color and short rays were found to persist. It, therefore, seems worthwhile to designate this as a new form.

Helianthus mollis Lam., forma **flavida** Steyermark, f. nov., a typo differt ligulis et disci floribus flavidis; ligulis brevioribus.—Prairie along railroad, route 36, 4.4 mi. northwest of western limit of Lentner, Shelby Co., Missouri, August 21, 1950, *Julian A. Steyermark, 70126*, type, in Herb. Chi. Nat. Hist. Mus.—

Julian A. Steyermark, Chicago Natural History Museum and Missouri Botanical Garden.

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BRAYA IN COLORADO

Reed C. Rollins

The discovery of a population of *Braya* in the high mountains of central Colorado in 1950 by Messrs. H. D. Ripley and R. C. Barneby is not only of interest but several problems arise as a result of it. This station is nearly a thousand miles south of the nearest known locality for the genus *Braya* in Alberta.[1] The Colorado plants are closely related to a wide-ranging and polymorphic arctic and subarctic species, *B. humilis*, which has often been placed in the genus *Torularia*. Abbe (1948) retained it in *Braya*, but more recently Böcher (1950), in a thorough cytotaxonomic study of Greenland material, chose to treat the species as a *Torularia*. To properly handle the Colorado plants, two problems need to be dealt with: (1) Are they one of the many isolated and distinctive populations of *Braya humilis*, or are they a distinct species? (2) Do they (and *B. humilis*) belong to the genus *Braya*, or should they be placed in *Torularia?* I shall attempt to answer the last question first.

Torularia would appear to have been originally founded upon *Sisymbrium* (*Braya*) *humile* (Schulz, 1922). However, one finds that Schulz, in this first published work using the name *Torularia* in generic rank, merely made a new combination without providing a generic description. The generic name *Torularia* was first validly published in Das Pflanzenreich (Schulz, 1924) and the genus was based on species formerly referred to subgeneric divisions in *Sisymbrium* and *Malcolmia*. *Torularia* was used as a sectional name in *Sisymbrium* by Cosson (1885) to contain the single species *S. torulosum*. Schulz raised Cosson's sectional

[1] This ignores the transfer by Jones (1929) of *Draba graminea* to *Braya*. Actually the species is unquestionably a *Draba*.

name to generic rank. From this, it follows that *Torularia torulosa* is the type species and becomes the point of reference for the generic name *Torularia*. When one considers the relationships of *Torularia*, using *T. torulosa* as a principal point of reference, it is prefectly clear that this genus as a whole is much more closely related to *Malcolmia* than it is to *Braya*. Furthermore, considerable stretching is needed to include *Braya humilis* in it. On the other hand, *B. humilis* has often been confused with *B. linearis*, which in turn was at one time included in *B. alpina*, the generic type species of *Braya*. The pattern of characteristics observable in *B. alpina* applies also in a general way to *B. linearis* and *B. humilis*. On morphological grounds, there is no sound reason for excluding *B. humilis* from the genus *Braya*. The latter is an older name than *Torularia* and takes precedence in any circumstance where the two are in direct competition.

Chromosome Numbers in Braya

Chromosome numbers so far reported for *Braya* are: *B. alpina*, 2n = 32 (Manton, 1932); *B. linearis*, 2n = 64 and *B. purpurascens*, 2n = 64 (Löve and Löve, 1948); *B. linearis*, n = 21, 2n = 42, and *B. humilis* (as *Torularia*) 2n = 56 (Böcher and Larsen, 1950). A collection of *B. humilis*[2] from Alaska (Drury, no. 3298) has 2n = 40. The Colorado population (Rollins, Weber, and Livingston, no. 5153) was counted from buds fixed in the field and was found to have n = 32. In studying fuelgen preparations of root tips of the Alaskan collection, Drury 3298, a great range in chromosome size within the compliment was noted. Some of the smallest chromosomes are about the same size as one arm of a medianly constricted large chromosome. Such small chromosomes could easily be mistaken for one arm of a large chromosome or, as was most often the case, one arm of a large chromosome was mistaken for a small chromosome. The tendency was to count more rather than fewer chromosomes in figures where there was any possibility of confusion. It was only after a close study of numerous preparations that 2n = 40 was established as a certainty for this collection.

From the above counts, polyploidy in the genus is seen to be well established. Thus one of the mechanisms having a direct

[2] I am indebted to Dr. L. O. Gaiser for the accompanying cytological data.

bearing on speciation and upon the expected variation within species has been demonstrated. Although it is not known whether apomixis occurs in the genus, it may not be amiss to point out that apomixis combined with polyploidy could easily account for the distinct but only slightly different populations of *B. humilis* so clearly indicated by Abbe (l. c.). All counts fit a polyploid pattern except those of n = 21 and 2n = 42 for *B. linearis* made by Böcher and Larsen. In high polyploids, the loss or gain of a few chromosomes is apparently easy and may affect the morphology and physiology of a particular race very little or none at all. It would be surprising to me if some aneuploidy did not occur in a genus such as *Braya*, where polyploidy is obviously so wide spread. However, further work is needed to fully clarify this apparent discrepancy of 2n = 42 and 2n = 64 in the same species. The discovery of 2n = 40 in an Alaskan population of *B. humilis* and of n = 32 in the Colorado population of *B. humilis*, subsp. *ventosa*, further ties this species into *Braya* and points against removing it to *Torularia.*

Braya humilis

Three different chromosome counts from as widely separated areas as Alaska, Colorado, and Greenland, representing the extremes in the range of *B. humilis* in North America, call for an explanation. It would be ideal to obtain many more counts from intermediately situated populations to determine the over all pattern for the species, but that is at present impossible. I have turned to pollen measurements to see whether there is any correlation between pollen size and chromosome number.

The pollen of *Braya humilis* is tricolpate with the longest axis considerably exceeding the shortest. In shape, the grains are probably *perprolate,* using the terminology of Erdtman (1952). The exine is prominently reticulately pitted and in this respect the different pollen samples studies were relatively uniform. Measurements were made from the extremities on both the long and short axes, including the exine. Ten grains of each sample were measured except in one instance where two size-classes were found, where ten of each size-class were measured.

The lowest chromosome number, 2n = 40, was found in Alaska material, *Drury, no. 3298*. Pollen of this same collection meas-

ured 32.1 × 19.1 μ (ave. of ten grains). In another Alaskan collection, *Drury, no. 2131*, filled grains averaged 30.5 × 20.5 μ. In this latter collection, non-filled (and non-staining) grains measured 22.5 × 15.1 μ. Nearly fifty per cent of the grains were in the latter class. Preparations showing both size-classes of grains undisturbed within the anthers were prepared in order to make certain there was no contamination involved. Unfortunately, pollen from the same collection used by Böcher (l. c.) to obtain chromosome counts was not readily available. However, *Braya humilis* is of restricted occurrence in western Greenland and the plants sampled are likely to be the same taxon as those from which chromosome counts were obtained. Pollen from a collection by *M. P. and A. E. Porsild, s. n.*, Aug. 4, 1914, averaged 33.0 × 19.4 μ. The pollen of the Colorado population averaged 36.7 × 20.0 μ. Thus it is seen that there is a rough correlation between pollen size and chromosome number, the Alaskan plants with 2n = 40 having pollen 32.1 × 19.1 μ; the western Greenland plants with 2n = 56 having pollen 33 × 19.4; and the Colorado plants with 2n = 64 having pollen 36.7 × 20. Other pollen measurements on American material were within the same general range—a collection from eastern Greenland, *Sørensen 4230*, referred to subsp. *arctica* by Böcher, having 31.6 × 18.6 μ; a collection from Anticosti Island, *Marie-Victorin and Roland Germain* 27–203, having 32.2 × 19.6 μ; and a collection from Fort Churchill, *Gillett 2242*, having 34.4 × 21.8 μ. However, a collection from southwestern Kansu, *J. F. Rock 12269*, has pollen somewhat smaller than that of the smallest of the American collections. The grains average 26.7 × 16.3 μ. Generalizations cannot safely be made on such meagre data, but there is an indication that lower chromosome numbers are to be expected in the Asiatic populations. This points to Asia as the area of origin for *Braya humilis*. As the species spread eastward through Alaska, polyploidization increased the chromosome number, so that the highest ploidy is found, so far as is known, at the greatest distances from its area of origin. Such assumptions as to the origin and spread of *B. humilis* are supported also by morphological details, there being a closer resemblance between Alaskan and Altai plants than between Altai plants and those from more remote stations in North America.

Both microcytes and giant pollen grains were found in a number of collections. The presence of unusually small or large grains is an indication of meiotic irregularity, particularly an ultimate unequal distribution of the chromosomes. These abnormalties are frequently associated with polyploidy and are most likely to occur in unbalanced polyploids, such as triploids, pentaploids, etc. Their persistence is often permitted in a given species by the presence of asexual reproduction. It is perhaps significant that in one of the Alaskan collections studied (*Drury, 2131*), there were two size-classes of pollen grains, as indicated above. The smaller unfilled grains represented nearly fifty per cent of the total. This is a strong indication of meiotic irregularity. The presence of such a high percentage of sterile grains may be taken as evidence that a high degree of fertility is not required for the survival of these particular plants. From this it may be inferred that some form of apomixis probably permits the circumvention of the usual sexual process. It is unfortunate that seeds were not available from this particular collection so that such a hypothesis could be tested.

Polyploidy coupled with apomictic reproduction would explain very neatly the genetic origin and maintenance of the divergent relatively uniform isolated populations found in *B. humilis* today. Unfortunately, we have only circumstantial evidence of apomixis being present. There is no proof at this time. On the other hand, polyploidy has been definitely shown in a comparison of populations from three widely separated areas and pollen studies indicate that an even wider range in chromosome numbers is probably present.

I am in agreement with Böcher (l. c.) that the time for preparing a comprehensive cytotaxonomic treatment of the *Braya humilis* complex has not yet arrived. Although there is room for much work on the American plants, the most serious impediment is our lack of information about the Asiatic plants belonging to this complex. After examining the specimens from Asia in the Gray Herbarium and comparing them with the plate in Ledebour's Icones (1830), and then checking them against Meyer's (1831) amplified description, I am not fully convinced that typical *B. humilis* occurs in North America. It has been commonly assumed that this was the case, but proof is not ob-

tainable from the limited Asiatic material at my disposal. At the present time, it is not at all certain whether we must treat *B. humilis* as a large polymorphic species with many distinctive local populations, or whether some of these may not actually represent distinct localized species.

In attempting to see what the relationships of the Colorado plants are to the various races of *B. humilis,* as described by Abbe (l. c.), it was soon evident that they do not belong to any of these six geographically localized populations. Nor do they agree in morphological details with northwestern North American material commonly placed in *B. humilis.* The nearest approach to any *Braya* is to Abbe's race 4 from Table Mountain in Newfoundland. The Colorado material falls within *B. humilis* if it is accepted as a wide-ranging polymorphic species as in Abbe's treatment. However, the plants are more distinctive than most of the races described by him. Since they about parallel the divergence found by Böcher in the north and east Greenland plants which prompted him to establish subsp. *arctica,* it seems appropriate to designate the Colorado population as a subspecies of *B. humilis.*

Braya humilis (C. A. Meyer) Robinson, subsp. **ventosa** subsp. nov. Herba perennis caespitosa; caulibus decumbentibus vel erectis 3–6 cm. longis; siliquis divaricatis 1.5–2 cm. longis, ca. 1 mm. latis.

Perennial, usually with an unbranched caudex; basal rosette well developed; stems several to numerous, pubescent with 2- to 3-pronged trichomes; basal leaves numerous, thickened, spatulate, entire or with a few teeth, sparsely pubescent with branched trichomes, 1–2 cm. long, 2–3 mm. wide; cauline leaves 1–3, petiolate, spatulate; inflorescence dense; infructescence much elongated, often occupying nearly the entire stem; petals white; sepals more or less persistent; pedicels stout, 1.5–3 mm. long; siliques divaricate, slightly curved, pubescent with mostly bifurcate trichomes, 1.5–2 cm. long, about 1 mm. wide; styles ca. 1 mm. long.

Type in the Gray Herbarium, collected on rocky slopes of eastern extension of North Star Mountain, 1.5 miles west of Hoosier Pass, border of Park and Summit Counties, Colorado, Aug. 7, 1951, *Reed C. Rollins and William A. Weber 51288.* Other collections seen: same location (in flower) July 7, 1951, *Reed C. Rollins, William A. Weber, and Charles Livingston 5153* (GH); same location, July 11, 1950, *H. D. Ripley and R. C. Barneby 10393* (GH).

Subspecies *ventosa* is definitely perennial with a well-developed taproot. The outer stems are prostrate or decumbent but the inner are mostly erect. Nearly the entire stem is occupied by

the elongated infructescence, the lower pedicels being subtended by leaf-like bracts. The sepals are quite persistent, remaining attached in many instances where the silique is fully mature. In this latter respect, subsp. *ventosa* is closer to *B. linearis* than it is to *B. humilis.*

The Colorado population was studied on two occasions in the summer of 1951. Both times I was accompanied in the field by Dr. William A. Weber of the University of Colorado and, on the first trip, also by Mr. Charles Livingston. On the first visit, we had great difficulty finding the population because of the small size of the plants and their tendency to grow nearly concealed by rocks or other plants. Had we not been given the most precise directions as to the exact location by Mr. Barneby, I am sure we would not have found it. The plants grow on a fairly steep rocky slope with a rather sparse covering of other tundra species. It is possible, of course, that other stations for *B. humilis*, subsp. *ventosa* will be discovered but it must be extremely localized in its occurrence or it would surely have been collected earlier.

In order to bring the nomenclature into conformity with our conclusions as to the generic disposition of *B. humilis,* the following new combination is required:

B. humilis (C. A. Meyer) Robinson, subsp. **arctica** (Böcher) comb. nov. Based upon *Torularia humilis*, subsp. *arctica* Böcher. Medd. om Grønl. Bd. 147. no. 7, p. 29.

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A FLORISTIC STUDY OF COOK COUNTY, NORTHEASTERN MINNESOTA

Fred K. Butters and Ernst C. Abbe

(*Continued*)

TYPHACEAE

Typha latifolia L. Seagull Lake, BA 941; Swamp (?) Lake, "L.W.K." 1; Schroeder, BA 1085.—Shallow pools and ditches; very local.

SPARGANIACEAE

Sparganium americanum Nutt. Sawbill Creek, Bg 117; Loon Lake, BR 6517; Pope Lake, L. W. Krefting 10; Cascade River, C. B. Reif A19.—Streams; locally abundant.

S. chlorocarpum Rydb. Royal River, BsH 258.—Sluggish stream.

S. chlorocarpum, var. acaule (Beeby) Fernald, Rhodora **24:** 29. Cross River, BR 6377.—In mud at edge of river.

S. angustifolium Michx. Partridge Lake, BA 792; "Bearskin Lake," U. S. F. S. (Aug. 28, 1935).

S. fluctuans (Morong) Robins. Sawbill Lake, Bg 118; Rove Lake, BBsH 105.—Locally abundant; BBsH 105 was growing in 5 ft. of water in a small pond.

S. minimum (Hartm.) Fries. Grand Portage, BA 967.—Shallow pools at edge of cedar swamp.

ZOSTERACEAE

Potamogeton Robbinsii Oakes. Northern Lights Lake, U. S. F. S. 43.

P. zosteriformis Fernald, Mem. Gray Herb., III, p. 36, 1932. Devil's Track River, U. S. F. S. 34; "Superior Forest," "A. H." (no date, s. n.).

P. foliosus Raf., var. macellus Fern. "Bearskin Lake," U. S. F. S. (Aug. 28, 1935).

P. Berchtoldi Fieber (typical). Seagull River, BA 901; East Pope Lake, "L. W. K." 13; Birch Lake, BA 805b.

P. Spirillus Tuckerm. Cross River, BR 6373; Birch Lake, BA 805.

P. epihydrus Raf., var. typicus Fernald, Mem. Gray Herb. III, p. 114. 1932. Swamp Lake, "L. W. K." 6; Devil's Track Lake, U. S. F. S. 36.—The submersed leaves are somewhat under 0.5 cm. in width, but the plants otherwise correspond to var. *typicus*.

P. EPIHYDRUS Raf., var. NUTTALLII (C. & S.) Fernald. Poplar Lake, BA 837; Rose Lake, MacMillan Brand & Lyon 203; Leo Lake, BR 6339; Pike Lake, U. S. F. S. (Jul. 13, 1937).

P. AMPLIFOLIUS Tuckerm. Sea Gull River, N 1685; Sawbill Lake, Bg 116; North Lake, MacMillan Brand & Lyon 209; Royal Lake, BsH 307; Devil's Track Lake, "U. S. F. S." 17.

P. NODOSUS Poir. *cf.* Ogden, RHODORA **45:** 123. Pigeon River, AA 588.

P. GRAMINEUS L., var. gramineus. *cf.* RHODORA **45:** 143. 1943. Seagull Lake, BA 939; Round Lake, Reif A4; Cross River, BR 6385; Swamp Lake, L. W. Krefting 11; South Fowl Lake, L. S. Cheney (July 10, 1891); Royal River, BsH 306; Temperance River, Reif Al.

P. GRAMINEUS, var. MAXIMUS Morong *ex* Bennett. Poplar Lake, BA 836; John Lake, BM 10779; Brule River, BR 4638, C. B. Reif (July 10, 1936).

P. NATANS L. Granite River, L. S. Cheney (July 1, 1891); East Pope Lake, "L. W. K." 18; North Lake, MacMillan Brand & Lyon 210; Cucumber Lake, "L. W. K." (July 1936); Christine Lake, L. W. Krefting 18 (7/7/37).

P. PRAELONGUS Wulfen. Birch Lake, BA 808; Loon Lake, Reif A28; Thunder Bay Dist., Ont. (South Fowl Lake), BABs 708.

P. RICHARDSONII (Benn.) Rydb. Hungry Jack Lake, BR 6345; Northern Lights Lake, U. S. F. S. 41; Mountain Lake, BAA 328c.

NAJADACEAE

NAJAS FLEXILIS (Willd.) Rostk. & Schmidt. Birch Lake, BA 804; Caribou Lake, L. W. Krefting (July 29, 1936).—The common species in the state.

N. GRACILLIMA (A. Br.) Magnus. Caribou Lake, L. W. Krefting (July 29, 1936).—Pretty well confined to soft water ponds and lakes; known from only two other localities in the state, Ramsey Co. and Itasca Park.

JUNCAGINACEAE

TRIGLOCHIN PALUSTRIS L. Grand Portage, R. M. Schuster A5309.—"At open, mucky edge of marl bog."

SCHEUCHZERIA PALUSTRIS L., var. AMERICANA Fernald. Sawbill Lake, Bg 13.—Small pond, infrequent.

ALISMATACEAE

ALISMA TRIVIALE Pursh. *A. Plantago-aquatica* L., var. *brevipes* (Greene) Samuelsson *ex* Marie-Victorin, Fl. Laur., p. 615 (1935). Sea Gull River, N 1679; Schroeder, BA 1065.—Infrequent.

We do not find a publication by Samuelsson himself of the combination cited above as a synonym. The combination is used by Marie-Victorin (*loc. cit.*) in 1935 and by Deam (Fl. Indiana, p. 87) in 1940, both of whom attribute it to Samuelsson. In 1931 Samuelsson made the combination

"*A. Plantago-aquatica* L. ssp. *brevipes* (Greene) Sam. n. comb." (Ark. Bot. 24A, no. 7, p. 19), but does not refer in his synonymy or text to having treated it previously as a variety. There is in the Herbarium of the University of Minnesota a specimen (N. C. Fassett 4139) distributed from the Herbarium of the University of Wisconsin labelled "*Alisma Plantago-aquatica* L., var. *brevipes* (Greene) Samuelsson Det. Samuelsson." It may well be that Samuelsson originally conceived of *A. brevipes* Greene as worthy only of varietal status and so labelled his material prior to publication, and subsequently changed his mind. The varietal combination then would be simply an herbarium name.

Sagittaria latifolia Willd. Alton Lake, Bg 115; East Pope Lake, "L. W. K." (July 1936).

S. latifolia, f. gracilis (Pursh) Robinson, Rhodora **10:** 31. Seagull River, BA 902; Kelso River, Bg 114; Loon Lake, BR 6519; Hungry Jack Lake, BR 6357.—Shores of ponds and in shallow streams.

S. cuneata Sheldon. Kelso River, Bg 113; Poplar Lake, BA 840; Pike Lake, U. S. F. S. (July 13, 1937).

HYDROCHARITACEAE

Elodea canadensis Michx. *Anacharis canadensis* (Michx.) Planch. Clearwater Lake, BA 943.—In 3 ft. of water, muddy bottom, infrequent.

GRAMINEAE

Bromus ciliatus L., var. ciliatus. *cf.* Fernald, Rhodora **32: 70.** West Pike Lake, BsH 204; Lima Mountain, BA 870; Grand Portage, Be 561, Be 475, R 7901.—Open tops of cliffs and dry hills, edge of woods, turf along sandy beach; general but not abundant.

B. Dudleyi Fernald, Rhodora **32:** 70. Lima Mountain, BA 891.—Trailside.

B. inermis Leyss. Brule River, BR 4637.—Sandy opening near river mouth; introduced.

Schizachne purpurascens (Torr.) Swallen, Jour. Wash. Acad. Sci. 18: 204. *Melica striata* (Michx.) Hitchc. South Lake, BA 781; Poplar Lake, D 45; Rove Lake, BBsH 98; Mountain Lake, BAA 269; North Fowl Lake, BABs 706; Mount Josephine, NE 2055; Tofte, BR 4465.—Woods, cliffs, and clearings; general and fairly frequent.

Festuca saximontana Rydb. *cf.* Fernald, Rhodora **37:** 251. South Fowl Lake, BM 10823; Pigeon Point, BAA 390, BAA 419; Lucille Island, BAA 367; Grand Portage, F. F. Wood 21; Mount Josephine, BA 185; Grand Marais, BR 4652 & 4653, BM 10767 & 10772.—Generally distributed along the shore of Lake Superior and throughout the northern part of the state.

The plants from the Point at Grand Marais approach *F. brachyphylla* Schult. (*cf.* Fernald, *loc. cit.*, p. 251; Abbe, Rhodora **38:** 142) but the anthers are not yet mature (in BM 10772 they are 0.9–1.2 mm. long). The spikelets of these plants are more purplish than in the rest of our Cook

County material but less so than in arctic and high alpine material. The Point at Grand Marais is one of the most nearly sub-arctic of the habitats known to us on the North Shore and nanism is to be expected, especially since this particular species grows in crevices in rocky shores which are occasionally beaten by the waves practically at the temperature of ice water. Since most of our collections fall clearly into *F. saximontana* we hesitate to call the Grand Marais plants *F. brachyphylla* especially since they come from an extreme habitat for the region. Furthermore we are of the opinion that the line between *F. saximontana* and *F. brachyphylla* is very tenuous, therefore we retain the Grand Marais plants within the collective species.

GLYCERIA BOREALIS (Nash) Batch. Poplar Lake, BA 847; Brule River, C. B. Reif A26; Temperance River, C. B. Reif A22.—Rooted in rock and muck bottoms one to two feet below surface of the two above-mentioned rivers, and on pond margins.

G. CANADENSIS (Michx.) Trin. West Pike Lake, BsH 184; Lima Mountain, BA 856.—Swampy spots; occasional.

G. STRIATA (Lam.) Hitchc. Sea Gull Lake, L 3699; South Lake, L. S. Cheney 17; Rove Lake, F. F. Wood 18; Lima Mountain, BA 857; Mineral Center, Be 641; Carribeau River, BR 4517.—Stream banks, moist portage trails, swamps; common.

G. STRIATA, var. STRICTA (Scribn.) Fernald, RHODORA **31:** 47. South Lake, BA 784; Birch Lake, BA 818.—Pond shores, sphagnum bogs.

G. GRANDIS S. Wats. Grand Marais, BA 979.—Around the "marais"; locally abundant.

G. FERNALDII (Hitchc.) St. John. Aspen Lake, BA 959.—In a gently flowing stream; very local.

POA ANNUA L. [11] Poplar Lake, BA 963.—Near habitations; introduced weed.

P. COMPRESSA L. Birch Lake—Poplar Lake, BA 817; Lima Mountain, BA 876; Grand Portage, BA 976; Mount Josephine, BA 1036, BA 1038; Grand Marais, BR 4654; Tofte, Lakela 7255.—Roadsides, along trails, rarely in undisturbed places; introduced.

P. PRATENSIS L. *sens. lat.* Brule River, BR 4526; Susie Island, OO 1148.—Gravelly beach; rare.

P. PRATENSIS, var. ANGUSTIFOLIA (L.) Sm. *cf.* Butters & Abbe, RHODORA **49:** 5. *P. angustifolia* L. Pigeon River, BR 4623½; Grand Marais, BR 4664.—Roadsides, etc.; infrequent and introduced.

P. SALTUENSIS Fern. & Wieg., RHODORA **20:** 122. Pigeon River, BR 4623; Mineral Center, BR 4596; Carribeau River, BR 4492.—Moist, shady river gorges and woodlands; infrequent.

P. SALTUENSIS, var. MICROLEPIS Fern. & Wieg., RHODORA **20:** 124. Mineral Center, BR 4582.—Cedar-spruce swamp; rare.

P. NEMORALIS L., var. INTERIOR (Rydb.) Butters & Abbe, RHODORA **49:** 6. *P. interior* Rydb. Gunflint Lake, BBl 377; Clearwater Lake, BBl

[11] The genus Poa in Cook Co., Minn. has been discussed at length by the writers in RHODORA **49:** 1–21. 1947.

416, BBsH 6, BA 961 A-F; Lima Mountain, BA 865, BA 881; Mountain Lake, BAA 256, BAA 286, BAA 308, BBsH 47, BBsH 67, BBsH 77; West Pike Lake, BsH 182; John Lake, BM 10817a; North Fowl Lake, BABs 670; Brule River, BR 4543.—Inland cliffs (slate and diabase), hill-tops, dry rocks near shore of Lake Superior; common.

P. nemoralis, var. montana Gaud., *emend.* Lindm. *cf.* Butters & Abbe, Rhodora **49:** 9. North Lake, Lange 8; Clearwater Lake, BA 72; John Lake, BM 10801; North Fowl Lake, BABs 668; Mount Josephine, BR 6326, BA 184; Mount Maud, BA 199, BA 202; Carribeau River, BR 4481, BR 4482.—Inland cliffs, dry tops of hills and bluffs, both inland and near Lake Superior, river mouths; frequent.

P. palustris L. Sea Gull Lake, BA 915; Mountain Lake—Watab Lake, BAA 316; Lima Mountain, BA 877; Susie Island, OO 1145, OO 1146; Grand Portage, R 5981, Be 467; Mount Josephine, BA 1034, BA 1040, BA 1043, BA 1046, BA 1049; Grand Marais, T. S. Roberts (s. n., no date); 12 mi. west Grand Marais, BA 757; Tofte, Lakela 7254.—Moist roadsides and portage trails, margins of woods; very common.

P. glauca Vahl. Mountain Lake, BBsH 47a; Pigeon Point, BAA 422, BAA 424, BA 1009, BA 1012; Clark's Bay, BAA 388, BAA 391; Porcupine Island, AA 576; Susie Island, AA 568; Mount Josephine, BA 1031, BA 1032, BA 1037; Reservation River, BR 4567; Grand Marais, BR 4505; Thunder Bay Dist., Ont. (Boundary Islands, Pigeon Bay), AA 592a.—Rocky shores and shingle beaches of Lake Superior, occasionally on inland cliffs; common.

P. glauca, subsp. conferta (Blytt) Lindm. Lucille Island, BAA 382, OO 1103; Grand Marais, Wood 13.—Islands, shores and hills adjacent to Lake Superior; infrequent.

P. glauca, subsp. conferta, var. laxiuscula (Blytt) Lindm. Mount Josephine, NE 2051.

P. glauca, subsp. glaucantha (Gaud.) Lindm. Bot. Notis. (1926): 275. Watab Lake, BAA 241; Clearwater Lake, Butters & Wherry (June 29, 1935), BBsH 123, BsH 156; Little Caribou Lake, BsH 410; Rocky Lake, BsH 378; Canoe Lake, BsH 381; Mountain Lake, BAA 258, BBsH 66; MacFarland Lake, BsH 372; South Fowl Lake, BsH 282; Royal Lake and River, BsH 240, BsH 358; Pigeon Point, BAA 422a, AA 590, BA 1007, BA 1013; Lucille Island, BA 350; Long Island, AA 547; Sailboat Island, AA 535; Mount Josephine, BA 164, BA 1041.—Inland cliffs; islands, shore rocks and hills adjacent to Lake Superior; common.

P. × tormentuosa Butters & Abbe, Rhodora **49:** 14. *P. glauca*, subsp. *glaucantha* × *P. nemoralis*. Hungry Jack Lake, BsH 424; Clearwater Lake, BBsH 2, BA 961G; Little Caribou Lake, BsH 410; East Pike Lake, BsH 233; South Fowl Lake, BsH 274, BsH 303; Royal River, BsH 336; Pigeon Point, BA 1008, BA 1010, BA 1011, BA 1014.—Cliffs mostly along the border lakes; occasional.

P. scopulorum Butters & Abbe, Rhodora **49:** 16. Winchell Lake, BA 135; Clearwater Lake, BA 97, BA 950, BA 87, BBl 471; Mountain Lake, BAA 261, BBsH 56; Mount Josephine, BA 184a.—Slate, diabase

and gabbro cliffs; occasional. A significant endemic species belonging to the section *Oreinos* (*sensu* Nannfeldt), an essentially alpine group which in eastern North America is otherwise represented by *Poa Fernaldiana* Nannf.

PHRAGMITES COMMUNIS Trin. *cf.* Fernald, RHODORA **43:** 286. Canoe Lake, BsH 374.—In shallow water by portage trail; infrequent.

AGROPYRON TRACHYCAULUM (Link) Malte, var. TYPICUM Fernald, RHODORA **35:** 169. Lima Mountain, BA 884; Grand Portage, BA 1029; Mount Josephine, BA 1042.—Mixed woods, dry hilltops.

A. TRACHYCAULUM, var. NOVAE-ANGLIAE (Scribn.) Fernald, RHODORA **35:** 174. Clearwater Lake, BBl 414; Mountain Lake, BAA 257, BBsH 49; Pigeon Point, R 6053, R 6281; Mount Josephine, BA 186; Mount Maud, BA 200.—Scree slopes, dry hilltops; occasional. BA 200 tends toward var. *glaucum* (Pease & Moore) Malte.

A. REPENS (L.) Beauv. (typical). *cf.* Fernald, RHODORA **35:** 184. Grand Portage, Be 477.—Roadsides; infrequent.

A. REPENS, f. TRICHORRHACHIS Rohlena. *cf.* Fernald, RHODORA **35:** 184. Brule River, BR 4523.—Rare; gravelly beach near river mouth. Apparently a range extension, since Fernald, *loc. cit.*, p. 184, has described its range as "Newfoundland and Saguenay Co., Quebec to Connecticut and western New York; Oregon." He gives essentially this range in Gray's Manual, ed. 8, but excludes Oregon.

A. REPENS, var. SUBULATUM (Schreb.) Reichenb., f. VAILLANTIANUM (Wulf. & Schreb.) Fernald, RHODORA **35:** 184. Grand Marais, R 5999.—Sandy, gravelly beach of Lake Superior; rare.

HORDEUM JUBATUM L. Grand Portage, Be 670, SS (June 28, 1948).—Sporadic as a roadside weed.

ELYMUS VIRGINICUS L., var. VIRGINICUS. *cf.* Fernald, RHODORA **35:** 198. Gunflint Lake, R 5451.—Very uncommon.

E. WIEGANDII Fernald, RHODORA **35:** 192. Grand Portage, BA 1024.—Thicket by brook; rare.

Reported most recently by Fernald in Gray's Manual, ed. 8, as occurring in "Alluvial soil, Gaspê Co. to L. St. John, Que., s. and s. w. to s. N. B., N. E. and Pa." making the occurrence in Cook County a considerable extension of range.

TRISETUM SPICATUM (L.) Richter, var. PILOSIGLUME Fernald, RHODORA **18:** 195. Pigeon Point, B (Sept. 3, 1927), BAA 425 & 448; Grand Marais, BM 10765 & 10766; Tofte, BR 4466, R 7818.—Shore rocks of Lake Superior.

T. SPICATUM, var. MOLLE (Michx.) Beal, Grasses N. A. 2: 377. Pigeon Point, BAA 389, BAA 449; Lucille Island, BAA 349.—Shore rocks of Lake Superior.

T. SPICATUM, var. MAIDENII (Gand.) Fernald, RHODORA **18:** 196. Pigeon Point, BAA 427, BBs 732, BBs 733, BBs 734, BBs 735; Porcupine Island, AA 575, AA 580, OO 1053; Grand Portage, BA 205.

T. SPICATUM—intermediates between var. *molle* and var. *Maidenii.* Pigeon Point, BBl 356, BAA 447; Lucille Island, BAA 348 & 380b; Grand

Marais, F. F. Wood (Jun. 29, 1891). *T. spicatum sens. lat.* is very abundant on the rocky shores and islands of Lake Superior; the intermediates between var. *molle* and var. *Maidenii* are apparently the most abundant phase of the *T. spicatum* complex in this region. The characters assigned to vars. *molle* and *Maidenii* vary independently, so that an infinite series of combinations and permutations as to stature, size of spikelets, density of spikes, and color are to be found in the region. There is a strong similarity of behavior in this respect to what may be expected in the variously selfed and backcrossed progeny of a cross involving vars. *molle* and *Maidenii* as the parental types.

Whether any of our collections can be identified with any of the more northern varieties listed by Louis-Marie (Rhodora **30:** 239) is not obvious from his work nor from the original descriptions upon which his transfers are based.

Avena fatua L. Hovland, Be 660.—One of the commonest weeds in the state, although by no means abundant in Cook Co.

Deschampsia flexuosa (L.) Trin. Pigeon Point, BAA 397, BAA 415, BBs 723; Grand Portage, BM 10888.—Rare; near the shore of Lake Superior. The collection made by Mrs. Abbe and the writers (397) is the first known from Minnesota. It was collected somewhat later the same summer (1937) near Duluth by Miss Lakela. The range for North America as reported by Hitchcock (Man. Grasses, U. S., p. 289) is "Greenland to Alaska, south to North Carolina, Michigan and Wisconsin; Oklahoma . . ."

D. caespitosa (L.) Beauv., var. glauca (Hartm.) Lindm. f. *cf.* Fernald, Rhodora **28:** 154. Pigeon Point, BBl 355, BAA 387 & 394, BAA 428 & 435, BBs 741; Porcupine Island, AA 573, OO 1015; Susie Island, OO 1147; Lucille Island, BAA 365, BAA 366, BAA 368, OO 1102; Long Island, AA 502, AA 551; Grand Portage Island, R 6026; Grand Marais, F. F. Wood (Jun. 29, 1891); Tofte, BR 4464, R 7817.—Localized; crevices of rocks, rocky shores of Lake Superior. The range of variation is great in this material, although it all comes within that allowed by Fernald (*loc. cit.*, p. 153). Expecially noteworthy are collections BAA 387 and BAA 368. The stiff leaves form tight dense tufts, the blades about 4 cm. long. The culms are very stiff, from 4 to 24 cm. high (including the panicle). The panicles are from 2 to 8 cm. long, having relatively few, rather short divergent branches which are few-flowered. The leaf blades on the culms are very short and hardly divergent giving the plants a very strict appearance. It is not unlikely that this is an ecological form associated with the limited accommodations available for the root system. It is however a form of distinctive appearance. Similar material has been collected on Isle Royale.

Danthonia spicata (L.) Beauv., var. pinetorum Piper *D. thermalis* Scribn. Sea Gull Lake, L 3674; Birch Lake, BA 799; Watab Lake, BAA 322a; Clearwater Lake, BBl 472; Lima Mountain, BA 872, BA 880; Mountain Lake, BAA 268, BBsH 36; East Pike Lake, BsH 211; South Fowl Lake, BM 10843; Pigeon Point, BAA 414; Sailboat Island, AA 543;

Grand Portage, BM 10887; Mount Josephine, BA 187; Mount Maud, BA 201; Grand Marais, BA 772.—Mostly on dry hilltops and talus slopes, and in cracks of shore rocks. Rare in Minnesota, being primarily known from the Arrowhead region. This is a category of *D. spicata* which has been variously treated. It was described by Piper (Erythea **7:** 103, Oct. 1899) as *Danthonia spicata pinetorum* from Mason Co., Washington. Piper says (*loc. cit.* p. 104) "Although the plant occurs widely separated from the range of *D. spicata* R. & S., it is scarcely more than a variety of that species, differing mainly in character of pubescence." It was described as a species by Scribner (U. S. D. A., Div. Agrostol. Circ. **30:** 5. 1901) as *Danthonia thermale* (*sic!*) from Yellowstone Park. It was recognized as a species by Piper (Flora Washington, Contrib. U. S. Nat. Herb. **11:** 122. 1906) under the name *Merethrepta pinetorum* for which he cites the synonym *D. thermalis*. Rydberg (Fl. Rocky Mts. and adjacent Plains) keeps it as a species and keys it as follows:

Empty glumes 11–13 mm. long, conspicuously nerved, broad;
 teeth of the lemma subulate, 1–2 mm. long . . . . 2. *D. thermalis*
Empty glumes 8–10 mm. long, narrow; teeth of the lemma ovate,
 often only 0.5 mm. long . . . . 3. *D. spicata*

Rydberg gives the range of *D. thermalis* as B. C.—Wash.—Wyo. and that of *D. spicata* as Newf.—N. C.—N. M.—B. C. In his Flora of the Prairies and Plains he extends the former to include "S. D." and the latter to include "Kans."

Hitchcock (U. S. D. A. Misc. Pub. 200: 303) reduces *D. thermale* to synonymy under *D. spicata* with the remark "A rather stiff western form with subsetaceous teeth has been described as *D. thermale* Scribn."

Rydberg's key reproduced above is much too categorical. There is continuous variation in the length of the glumes, not a break between 10 and 11 mm. The other glume characters noted by Rydberg seem to be wholly illusory. The length of the teeth of the lemma also varies greatly, and it is even possible to find lemmas with one tooth setaceous prolonged and the other nearly triangular. Nevertheless, nearly all Rocky Mountain and far western material that we have seen has larger spikelets than most eastern material, and somewhat longer and sharper teeth on the lemmas, though there is pretty complete intergradation. The western plant seems to be a fairly distinct geographical variety.

All our Cook County plants seem to belong to var. *pinetorum*, also two specimens from Thomson, Minn. collected by J. H. Sandberg in June and July 1891. All other Minnesota specimens in the Herbarium of the University of Minnesota are ordinary *D. spicata*. Other eastern specimens of this variety that we have seen are: Keweenaw Co., Mich. O. A. Farwell 534; Isle Royale, Mich. W. S. Cooper 285; and Quiddy Viddy, Newfoundland,, B. L. Robinson and H. Schrenk 199. The amount of pubescence on the leaves is very variable and does not correlate with any of the other characters. The Sandberg specimens mentioned above are nearly glabrous.

Typical *D. spicata* and its var. *pinetorum* may be contrasted as follows:

Typical *D. spicata*	var. *pinetorum*
1. Glumes mostly under 1 cm. in length except for occasional stray spikelets	Spikelets practically all over 1 cm. long and up to 13 mm.
2. Teeth of summit of lemma acute and relatively short	Teeth of summit of lemma subsetaceous and relatively long

Calamagrostis purpurascens R. Br. *cf.* Fernald, Rhodora **35:** 213. Watab Lake, BBsH 108; Mountain Lake, BAA 263, BBsH 58; South Fowl Lake, BsH 275; Thunder Bay District, Ont. (South Fowl Lake), BABs 711.—Cliffs of the Border Lakes; rare.

This is one of the notable species and range extensions of the region. Fernald (*loc. cit.*) characterizes it as having "a remarkably disrupted range" giving this as "the unglaciated margin of Greenland; arctic northwestern Canada, thence along the Cordillera to South Dakota, Colorado, Nevada and California; with the only known station in the East (south of Greenland) a single colony on one of the highest cliffs of Bic, Quebec." In Gray's Manual, ed. 8, Fernald adds only the Mountain Lake station cited above and L. Mistassini.

C. canadensis (Michx.) Nutt., var. canadensis. *cf.* Stebbins, Rhodora **32:** 39. Watab Lake, BAA 317; Mountain Lake, BAA 307; Susie Island, OO 1016; Grand Marais, BA 756.—Roadsides; frequent. BA 756 is a phase with hirsutulous sheathes.

C. canadensis, var. Macouniana (Vasey) Stebbins, Rhodora **32:** 41. Gunflint Lake, BBl 380.—The most abundant of the varieties in the state.

C. canadensis, var. robusta Vasey. Pigeon Point, BAA 418; Porcupine Island, AA 579; Susie Island, OO 1150; Long Island, AA 525. The only other Minnesota collection of this variety in the Herbarium of the University of Minnesota is from Two Harbors, also on the shore of Lake Superior.

C. canadensis, var. scabra (Presl) Hitchcock, Amer. Jour. Bot. **21:** 135. *C. canadensis*, var. *Langsdorfii* (Link) Inman. *cf.* Stebbins, Rhodora **32:** 43. Lucille Island, BAA 358.

While Stebbins (*loc. cit.*) has seen material of this circumpolar variety from nearby Isle Royale, none from Minnesota was apparently at hand when he prepared his revision of Calamagrostis. This, from shore rocks of Lake Superior, would then appear to be the first to be reported from Minnesota (*cf.* Fernald, Gray's Manual, ed. 8, p. 157).

C. inexpansa A. Gray, var. brevior (Vasey) Stebbins, Rhodora **32:** 50. Lima Mountain, BA 875, BA 879; Pigeon Point, BAA 450; Belle Rose Island, OO 1065; Long Island, OS 1117.—General in the state, although not much collected.

Agrostis alba L. Partridge Lake, BA 789; Lima Mountain, BA 866; Grand Portage, Be 673; Mount Josephine, BA 1035.—Trails, openings in woods, and fields; questionably native.

A. scabra Willd. *cf.* Fernald, Rhodora **35:** 207. South Lake Trail, BA 812; Clearwater Lake, BBl 465, BA 960; Little Caribou Lake, BsH

405; Porcupine Island, OO 1014; Susie Island, AA 567; Grand Portage, Be 622; Grand Marais, BR 6912.—Cliffs, trails and rocky lake shores; frequent.

A. GEMINATA Trin. Clearwater Lake, BBl 415; Mountain Lake, BBsH 37.—Cliffs.

A. GEMINATA, f. EXARISTATA Fernald, RHODORA **35:** 211. Sea Gull Lake, L 3677; Clearwater Lake, BBl 465, BsH 161; Mountain Lake, BBsH 55; Lucille Island, BAA 355; Long Island, AA 546.—Cliffs and shore rocks.

CINNA LATIFOLIA (Trev.) Griseb. Poplar Lake, L. W. Orr 4; Hungry Jack Lake, BR 6331; Grand Portage Bay, R 6018; Kimball Creek, R 2611.—Shady woods and moist portage trails.

PHLEUM PRATENSE L. South Fowl Lake, BsH 263; Grand Portage, Be 564; Brule River, BR 4527.—Portage trails, roadsides, meadows, beaches; introduced and thoroughly naturalized as the commonest hay grass along with *Agrostis alba* L.

ALOPECURUS AEQUALIS Sobol. *cf.* Fernald, RHODORA **27:** 196. South Fowl Lake, BsH 310; Royal River, BABs 713; Grand Portage, Be 470.—On occasionally flooded portage trails and rubble beaches; locally abundant but infrequent. BABs 713 has the repent habit and inflated sheathes of *A. aequalis*, var. *natans* (Wahlenb.) Fernald (*loc. cit.* p. 198) but has the spikes up to 5 cm. in length and the upper leaf sheath up to 7 cm. long, in which it exceeds the dimensions given by Fernald in his description of the variety.

ORYZOPSIS ASPERIFOLIA Michx. Poplar Lake, D 29.—Roadside; infrequent.

O. PUNGENS (Torr.) Hitchc., Contr. U. S. Natl. Herb. 12: 151. Sea Gull Lake, L 3609; Moss Lake, D 134; Rove Lake, BBsH 99; Mountain Lake, BAA 230.—Dry rocks and cliffs; northern part of the state, except for an occurrence in a southern relic stand of Jack pine in the Root River Valley (Fillmore County) in the Driftless Area.

The specific concept which we are here following is that expressed by Hitchcock (*loc. cit.* and Manual Grasses U. S., p. 417), rather than that expressed by Fernald (RHODORA **35:** 215) in his synonymy for *O. canadensis* (Poir.) Torr., namely "(*Oryzopsis pungens* (Torr.) Hitchc.; *Stipa canadensis* Poir.)." It is abundantly clear from cytological and statistical studies made by Dr. B. Lennart Johnson (Bot. Gaz. **107:** 1–32. 1945) that *O. pungens* and *O. canadensis* are two distinct species and that Hitchcock's recognition of this species is justifiable.

PHALARIS ARUNDINACEA L. Gunflint Lake, F. F. Wood 5 & L. S. Cheney (Jul. 18, 1891).—Infrequent.

HIERCHLOË ODORATA (L.) Beauv. Grand Portage, BAA 455; Mount Josephine, NE 2050.—Open woods; not at all abundant in Cook Co., although general in Minn.

Our material is a good match for European material in the Herbarium of the University of Minnesota rather than for *H. odorata*, var. *fragrans* (Willd.) Richter (*cf.* Fernald, RHODORA **19:** 152).

Zizania aquatica L., var. angustifolia Hitchc. Rhodora **8:** 210. Royal Lake, BsH 308.—Shallow lakes and ponds with mud bottom; locally abundant, but suitable habitats rather scarce.

Panicum linearifolium Scribn. Sea Gull Lake, L 3694.—In lichen mats on rocky ridge.

P. subvillosum Ashe. Sea Gull Lake, L 3701.—Dry, rocky ridge.

CYPERACEAE

Dulichium arundinaceum (L.) Britton. East Pope Lake, "L. W. K." 19; Hungry Jack Lake, BR 6352.—Edge of ponds and lakes; rare.

Eleocharis acicularis (L.) R. & S. Lake Saganaga, BA 938; Poplar Lake, BA 942.—Shallow margins of lakes.

E. ovata (Roth) R. & S., var. Heuseri Uechtritz *cf.* Svenson, Rhodora **31:** 214. Mark Creek, C. B. Reif A23 (*teste* "?" H. K. Svenson, 1945).—Mucky stream bottom.

E. Smallii Britton *cf.* Svenson, Rhodora **41:** 63. Seagull River, BA 936; Round Lake, C. B. Reif A13; Little Gunflint Lake, D. Lange (June 29, 1917); Leo Lake, BR 6338.—Shallow water, often on sandy bottom. The above collections, before checking by H. K. Svenson in 1945, had been referred to *E. palustris* (L.) R. & S., var. *major* Sonder.

E. calva Torr. *cf.* Svenson, Rhodora **41:** 63. Pigeon River, BR 4609 (*teste* "?" H. K. Svenson, 1945).—River bank.

E. nitida Fernald. Schroeder, BA 1063, L 6399, L 6405, L 6426, OO 993.—In roadside ditch; very rare. This fascinating little *Eleocharis*, with its fully ripe golden-yellow achenes and forming dense sods in which its rhizomes were densely interlaced, is represented for the first time in Minnesota by BA 1063 (Aug. 15, 1944). It was one of the last collections made by Dr. Butters in Cook County on his last collecting trip, and his delight over the find is memorable.

The occurrence of *E. nitida* in Cook County is a notable range extension. It was reported by Svenson (Rhodora **34:** 203) as seen by him from Newfoundland (4 collections), Quebec (1 collection), Nova Scotia (1 collection), and New Hampshire (1 collection). Specimens (authenticated by H. K. Svenson) in the Herbarium of the University of Minnesota which extend this range are:—from Douglas County, Wisconsin (J. W. Thomson, Jr. 5235, Jul. 4, 1943), from Glacier, B. C. (F. K. Butters, Jul. 30, 1913; F. K. Butters, Sept. 1920). Additional stations in n. e. Minnesota have been reported by Lakela (Rhodora **49:** 81–82). Its discovery in Cook County adds one more to the list of species which were first intensively studied in sub-boreal eastern America, and are now being found in the Great Lakes area.

E. elliptica Kunth *cf.* Svenson, Rhodora **41:** 65. Grand Portage, BR 6300 (! H. K. Svenson, 1945).—Border of pond in cedar woods.

Scirpus cespitosus L., var. callosus Bigel. *cf.* Fernald, Rhodora **23:** 24. Pigeon Point, BAA 412; Morrison Bay, BBs 724; Porcupine Island, OO 1050; Susie Island, R 6061; Lucille Island, N 1655, BAA 359; Grand Marais, BR 4650, R 5965, BA 51, BR 6911; Tofte, R 7820.—Forming mats on moist rocks of the shore of Lake Superior.

Elsewhere this occurs in the state farther west along the north shore of Lake Superior, in Ramsey County, and in a marl bog in the Minnesota Valley in Scott County. The latter is *not* the calcicolous form with dark basal bracts and more delicate culms, described by Fernald as var. *delicatulus* (RHODORA **23:** 25).

S. HUDSONIANUS (Michx.) Fernald, RHODORA **8:** 161. Grand Portage, BR 6301, Butters and Wherry (June 29, 1935), SS 12032; Schroeder, L 3724, L 6408.—Cedar swamp, swampy roadside; infrequent. The only other localities for the state, as represented in the Herbarium of the University of Minnesota, are in Lake and St. Louis Counties and near Park Rapids.

S. SUBTERMINALIS Torr. Brule River, C. B. Reif A28; Temperance River, C. B. Reif A21.—Sandy and rocky river bottoms.

S. ACUTUS Muhl. *ex* Bigel. *cf.* Fernald, RHODORA **22:** 55. Bearskin Lake, U. S. F. S. (Aug. 25, 1935).

S. FLUVIATILIS (Torr.) Gray. Lake Saganaga, L. S. Cheney (Jul. 23, 1891).

S. RUBROTINCTUS Fernald. Grand Portage, Be 548, R 7899.—Old portage trail, turf.

S. PEDICELLATUS Fernald. Sea Gull River, BA 935; Pigeon River, BR 6268.—Marshy ground, and in streams.

S. ATROCINCTUS Fernald. Sawbill Lake, Bg 12; Gunflint Lake, BR 6281; Hungry Jack Lake, BR 6337; West Pike Lake, BsH 174; Grand Portage, Be 576.—Old portage trails, roadside ditches, moist ground.

S. ATROCINCTUS, f. BRACHYPODUS (Fern.) S. F. Blake. Clearwater Lake, BBl 438.—Gravelly shore.

ERIOPHORUM SPISSUM Fernald, RHODORA **27:** 208. Clark's Bay, BAA 400; Schroeder, NBr 3197.—Muskegs.

E. ANGUSTIFOLIUM Honckeny. Sea Gull Lake, L 3671; Cross River, BA 912.—Sphagnum bogs; local and apparently infrequent.

RHYNCHOSPORA ALBA (L.) Vahl. Grand Portage, BR 6299.—Cedar forest.

CAREX STIPATA Muhl. Clearwater Lake, BsH 153; Grand Portage, Be 473, BA 1051, SS 12022.—Moist areas along trails.

C. DISPERMA Dewey. Sea Gull Lake, L 3721; North Lake, D. Lange (Jul. 1, 1917); Winchell Lake, BA 142; Poplar Lake, D 51; Clearwater Lake, BA 98; South Fowl Lake, BABs 639; Clark's Bay, BAA 402; Grand Portage, R 5963, BA 974; Mineral Center, BR 4579.—Moist situations generally; common.

C. TRISPERMA Dewey. Sea Gull Lake, L 3712; Mountain Lake, BBsH 74; Clark's Bay, BAA 399; Grand Portage, R 6007, BA 975.—In acid bogs; common.

C. TENUIFLORA Wahlenb. Between Sea Gull Lake and Lake Saganaga, BA 909, BA 910.—Mucky soil in muskeg.

C. CANESCENS L. Porcupine Island, BBs 753, OO 1019; Susie Island, OO 1039; Lucille Island, OO 1087; Long Island, BAA 468.—Moist places by rock pools.

C. canescens, var. loliacea Laestad. Grand Marais, BM 10768.—On the "Point."

C. canescens, var. subloliacea Laestad. Birch Lake, BA 829; Rove Lake, F. F. Wood 7; Watab Lake, BBsH 18; Mountain Lake, BAA 287; Pigeon Point, BAA 441; Porcupine Island, AA 569; Long Island, AA 529; Grand Portage, BA 973.—Moist areas near pools and portage trails. The leaves of the over-mature collection AA 569 are very narrow (1.5–2 mm.) and not markedly glaucous (in the latter respect resembling Pl. Gray. Exsicc. 530), but this may be because of age in our material.

BAA 441 is very depauperate. The culms are 0.6 to 1.2 dm. high and tend to be curved and the leaves are narrow (about 0.5 mm. wide), so that all together it simulates var. *fallax* F. Kurtz, *ex* Kükenth. as described by Kükenthal (Pflanzenreich, IV: 20, p. 217).

C. brunnescens (Pers.) Poir. Sea Gull Lake, L 3712; Clearwater Lake, BBsH 4; Mountain Lake, BBsH 90; South Fowl Lake, BABs 641; Royal Lake, BM 10852; Clark's Bay, BAA 392; Porcupine Island, BBs 750, BBs 751; Grand Portage, R 5986; Mineral Center, BR 4597.—Mostly in damp woods; common.

C. Deweyana Schw. Loon Lake, D 166; Rove Lake, BBsH 113; Mountain Lake, BAA 306; East Pike Lake, BsH 217; North Fowl Lake, BABs 671; South Fowl Lake, BABs 620; Mineral Center, BR 4602; Grand Marais, BR 4661.—Cliffs and dry slopes.

Mackenzie's statement (N. A. Fl. 18: 116) that the perigynia vary in length from 4.5–5.5 mm. does not hold. Many specimens in the Herbarium of the University of Minnesota labelled *C. Deweyana* by Mackenzie have perigynia only 4 mm. long, and this excludes consideration of *C. leptopoda* Mackenzie and *C. Bolanderi* Olney.

C. cephalantha (Bailey) Bicknell. Birch Lake, BA 828; Grand Marais, R 5962.—Moist places on rocks near the lake shore.

C. angustior Mackenzie. Sea Gull Lake, L 3685; Clearwater Lake, BsH 167; Mountain Lake, BBsH 144; West Pike Lake, BsH 173; Grand Portage, BM 10879; Schroeder, BA 1058.—Portage trails, wet woods, swampy openings, wet roadsides.

C. scoparia Schkuhr. Schroeder, BA 1071.—Roadside ditch.

C. tribuloides Wahlenb. Grand Portage, R 7896.—Edge of beach.

C. projecta Mackenzie. Grand Portage, Be 476; Grand Marais, H. W. Slack (July 1892).—Edge of woods.

C. Crawfordii Fernald. Sea Gull Lake, BA 919; Gunflint Lake, F. F. Wood 11, L. S. Cheney 9; Poplar Lake, BA 846; South Fowl Lake, BsH 296; Grand Portage, Be 590; Schroeder, BA 1084; Thunder Bay Dist., Ont. (Mountain Lake), BAA 314.—Rubble beaches, rocky shores, roadsides.

C. Merritt-Fernaldii Mackenzie. Clearwater Lake, BBl 453; North Fowl Lake, BABs 669; Grand Portage, R 7889.—Ledges and shoulders of cliffs, clearings. Not cited by Mackenzie (N. A. Fl. 18: 156) as seen from Minnesota, but omitted through an oversight because several sheets from the state in the Herbarium of the University of Minnesoata bear his annotations.

C. XERANTICA L. H. Bailey. Watab Lake, BA 117 (teste M. L. Fernald).—Dry hill-top. First authentic record for Minnesota of this species of "prairies and plains, Manitoba to Alberta and southward to New Mexico" (Mackenzie, N. A. Fl. 18: 168). Some other prairie plants, such as *Heuchera Richardsonii* and *Danthonia spicata*, var. *pinetorum* also occur on these dry hilltops.

C. ADUSTA Boott. Mountain Lake, BBsH 40.—Hill-top.

CAREX AENEA Fernald in Cook County, Minnesota.—Our material from Cook County, Minn. gave us a great deal of trouble when we attempted to identify it by using the keys in Fernald (Proc. Amer. Acad. Arts & Sci. 37: 480, 1902), in Gray's Manual (ed. 7) and in Mackenzie (N. A. Fl. 18: 123). The chief problem lay in distinguishing "*C. foenea*" (*C. argyrantha* Tuckerm. *in* Dewey; *cf.* Svenson, RHODORA **40:** 325) from *C. aenea* Fernald. These keys utilize various combinations of veininess, color and nature of the beaks of the perigynia and the color of the scales, depending on the key involved. Our specimens, in part, insisted upon straddling the lines drawn between the two species, although a fair proportion of them fell clearly into *C. aenea*. Nor were the detailed descriptions of help in resolving the difficulty. Finally in desperation we appealed to Professor Fernald for authentic material of "*C. foenea*" (*C. argyrantha* Tuckerm.) which we lacked in the Herbarium of the University of Minnesota. He kindly sent us a number of sheets, and with their help and with the sheets cited in connection with his original description of *C. aenea* we arrived at the following characteristics of the perigynia which could be used independently of their form or veininess:

Wings a little wider in *C. argyrantha* and with their margins irregular-laciniate, while in *C. aenea* the margins are dentate-serrate, the individual teeth acuminate.

Ventral surface so thin in *C. argyrantha* that the dark achenes may be seen through the tissue, while this is not possible in *C. aenea*. Also the tissue of this surface is more cellular in *C. argyrantha* than it is in *C. aenea*.

It is desirable to point out a by-product of our study of the achenes. These are described by Mackenzie (*op. cit.*) as dull in *C. aenea*. This is true, but with marked limitations. The appearance of the achene is a matter of age. In a specimen collected by Dr. Rosendahl (no. 6000), achenes from young inflorescences may be compared with those of the previous year, the culms all being attached to the same root system. The young achenes are dull, and minutely pitted, while mature achenes are markedly shiny and smooth probably because of the development of a thick layer of cutin. Very mature achenes develop a cloudiness which is associated with the development of air pockets under the cuticle. This cloudiness is readily dispelled by boiling the achenes in water and it reappears upon their drying out. The nature of the surface appearance of the achene therefore has but little diagnostic value, since in mature material it will range from shiny to cloudy.

Our Cook County material, using the criteria described in the first paragraph above, turned out to be *C. aenea* exclusively, but varied con-

siderably in form and veininess of the perigynium and in the form of the achene. More than half of the specimens fell clearly into the type of material originally described by Fernald and exemplified by his collection of June 8, 1901 (gravelly bank, Orono, Maine). These specimens have ovate-lanceolate perigynia which are veinless to moderately veined on the ventral face, and ovate achenes. The balance of our specimens fall into three categories: (*a*) plants with perigynia typically ovate-lanceolate, but more veiny on the ventral surface, and with narrow leaves; (*b*) one collection in which the perigynia are suborbicular to broadly ovate, the venation as in the typical material; (*c*) plants with the perigynia elliptic-lanceolate and rather strongly veined on the ventral face. It appears to us that as the species is studied over its east-west range, that there is a tendency for somewhat more variation in some of its characteristics in our area than at the eastern limits of its occurrence. These variants are considered in more detail below.

Carex aenea Fernald (typical). Proc. Amer. Acad. Arts & Sci. **37:** 480. 1902. Perigynia ovate-lanceolate, veinless to moderately veined on the ventral face; achenes ovate. lectotype, M. L. Fernald, June 8, 1901, gravelly bank, Orono, Maine (in Herb. Gray).

C. aenea, f. **extrapolata**, n. f. Utriculi ventre nervosi, ovati-lanceolati; nuces ovatis. Foliis 1.75–2.5 mm. latis. type, *Butters, Burns & Hendrickson 102*, Jul. 11, 1938, thin soil on diabase, top of cliff south of Rove Lake, Cook County, Minn. (in Herb. Minn.). Other specimens from Cook County, Minn. (in Herb. Minn.)—F. F. Wood 12, Jul. 20, 1891, Mosquito Bay, Gunflint Lake; Butters, Burns & Hendrickson 57a, Jul. 7, 1938, on rocks along base of cliff, west end of Mountain Lake; Butters, Abbe & Burns 674, Jul. 1, 1940, cliff on west side of North Fowl Lake; Butters & Moore 10822, Jul. 2, 1939, top of bluff above Pigeon River at lower end of South Fowl Lake; Butters & Moore 10831, Jul. 2, 1939, cleft in cliff above Pigeon River at lower end of South Fowl Lake.

This form differs from typical *C. aenea* in the more veiny ventral surface of the perigynium, and in the relatively narrow leaves (1.75–2.5 mm. in width); it resembles typical *C. aenea* in its ovate-lanceolate perigynium and ovate achene.

C. aenea, f. **flumini-regalis**, n. f. Utriculi ventre nervosi, ellipticis-lanceolatis; nuces ellipticis, ca. 2.2 × 1.5 mm. Type, *Burns & Hendrickson 338*, Jul. 29, 1938, east-facing cliff ⅜ mi. east of the source of the Royal River, Cook County, Minn. (in Herb. Minn.). Other specimens from Cook County, Minn. and from near-by Ontario (in Herb. Minn.)—Abbe & Abbe 542a, Aug. 19, 1937, Sailboat Island; Rosendahl 5983, Aug. 10, 1929, along forest road along crest Hat Point, Grand Portage; Butters, Sept. 11, 1929, Isle St. Ignace, Ont.

This form differs from typical *C. aenea* in its elliptic-lanceolate perigynia which are rather strongly veined on the ventral face, and in its elliptic achenes. In all of the collections the achenes are fairly glossy, presumably because the plants were collected well along in the growing season. The lack of diagnostic significance of this character has been pointed out above.

The extreme phase referred to earlier, in which the perigynia are suborbicular to broadly ovate, and somewhat veiny on the ventral face, and with the achenes elliptic as in f. *flumini-regalis*, is represented by but a single collection. It is therefore not considered desirable to assign a name to it until more material becomes available. The collection involved is Butters & Buell 334, Jul. 7, 1932, brushy hill-top MacFarland Lake, Cook County, Minn.

C. PRATICOLA Rydb. *C. pratensis* Drejer. Watab Lake, BA 118; Clearwater Lake, BA 63, BA 127; Mountain Lake, BAA 249, BBsH 48; South Fowl Lake, BM 10842; Lutsen, NBr 3159.—Cliffs. Not represented heretofore in the Herbarium of the University of Minnesota, nor is it mentioned by Mackenzie (N. A. Fl. 18: 141) as seen from Minnesota.

C. LEPTALEA Wahl. Sea Gull Lake, L 3711; Moose Lake, BAA 285; Pigeon River, BR 4557; Schroeder, BA 1078.—Moist portage trails, roadside ditches, spruce-cedar and tamarack swamps; common.

C. BACKII Boott. Watab Lake, BA 119, BAA 243; South Fowl Lake, BM 10819, BM 10840.—Cliffs and hill-tops; rare. This has been collected from but three other localities in Minnesota, namely Taylor's Falls, Itasca Park and near Duluth.

C. SUPINA Wahlenb. Clearwater Lake, BA 128.—Cliff talus; very rare. There are no other specimens from Minnesota in the Herbarium of the University of Minnesota. It was reported from Minnesota under the name *C. obesa* All., var. *minor* Boott by L. H. Bailey (Bot. Gaz. **17:** 148) as collected by F. F. Wood upon high bluffs at South Fowl Lake. South Fowl Lake is in Cook County about seventeen miles east as the crow flies from Clearwater Lake where we collected it. Presumably it is Bailey's report of Wood's collection which has led Mackenzie (N. A. Fl. **18:** 182) and Rydberg (Fl. Pr. & Pl., 177. 1932) to include Minnesota within the range of this species. The station at South Fowl Lake has been lost for nearly half a century, so that our find of the species at Clearwater Lake in 1936 is a desirable reaffirmation of its presence in the state.

It is a wide-spread species, occurring according to Böcher (Medd. Grønl. 106, no. 2, p. 237. 1938) in central, south, and east Europe, Caucasus, Altai, Himalayas, East Siberia, Athabaska-Great Slave Lake region of Canada. Duman (Cath. Univ. Amer., Biol. ser. **36:** 65) reports it from Baker Lake and Churchill in Canada, and in East and West Greenland. It is characterized by Böcher as being a "pronouncedly continental subarctic steppe plant" outside of Greenland and as occurring in Greenland in "inland" localities sometimes ranging high up on the mountains on dry southern slopes. The cliff-talus on which it was collected by us in Cook County is well-drained and north-facing, and has relatively little vegetation on large portions of the slope, so that competition with the usual temperate shade-producing species is not a factor in its survival. The presence of *C. supina* in Cook County seems to be the southernmost point in its range in North America.

C. COMMUNIS L. H. Bailey. Poplar Lake, D 96; Clearwater Lake, BA 891.—Dry cliffs and woods.

C. Peckii Howe. Loon Lake, D 161; North Lake, D. Lange 4; Clearwater Lake, BA 62, BA 79a; Mountain Lake, BAA 253, BAA 271, BBsH 122; John Lake, BM 10807; South Fowl Lake, BABs 615, BABs 616; Pigeon River, BR 4613; Carribeau River, BR 4503; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 691.—Cliffs, ravines, and rocks.

C. deflexa Hornem. Loon Lake, D 163; Poplar Lake, D 41, D 43, D 88; Rove Lake, BBsH 104; Clearwater Lake, BA 69a, BA 70, BA 78.—Cliffs and dry open pine woods on ridges. Our material has slender rootstocks as called for in Mackenzie's description (N. A. Fl. 18: 199). In Gray's Man. (ed. 8) it is described as "tufted" and Exsicc. Grayanae no. 78 is tufted with no evident rootstocks. However, material collected by Collins and Fernald (St. Jean l'Evangéliste, Nouvelle, Quebec, July 19 & 20, 1904), as well as other specimens from the north-east, have the slender rootstocks described by Mackenzie.

This species was not represented from Minnesota in the Herbarium of the University of Minnesota prior to our collections of 1936 at Clearwater Lake. Nor is it cited by Mackenzie (*loc. cit.*) as seen from Minnesota. Apparently it is a new record for the state.

C. Rossii Boott. Thunder Bay Dist., Ont. (North Fowl Lake), BABs 692.—Cliff, rare. There is only one collection from Minnesota in the Herbarium of the University of Minnesota (J. H. Sandberg, Carlton Co., June 1891). This northwestern plant is certainly to be expected in Cook County.

C. umbellata Schkuhr *cf.* Fernald, Rhodora **44:** 288. *C. rugosperma sensu* Mackenzie (N. A. Fl. 18: 205). Sea Gull Lake, L 3610.—In lichen mats on high rocks.

C. abdita Bicknell. *cf.* Fernald, Rhodora **44:** 288. *C. umbellata* Schkuhr *sensu* Mackenzie (N. A. Fl. 18: 204). Clearwater Lake, BA 79, BA 99; Clark's Bay, NBr 3227A; Lucille Island, BAA 361.—Inland cliffs and shore rocks. Both BA 99 and BAA 361 have the beak short and therefore nearly triangular. NBr 3227A varies a great deal in the length of the beak of the perigynium in the same plant, from less than, to equal to the length of the body of the perigynium. The variation seems to be associated with the position of the achene in the perigynium since a shortening of the beak corresponds with a longer base of the perigynium.

The absence of scurf and the lighter color of the achenes places all of our material cited above in *C. abdita* (i. e., *C. umbellata sensu* Mackenzie), rather than in *C. umbellata* Schkuhr (i. e., *C. rugosperma sensu* Mackenzie). The shape of the achenes as given by Mackenzie (*op. cit.*) is not of particular assistance, because we have not only seen achenes in *C. umbellata* which are "oblong-obovoid" as Mackenzie describes them, but also those which are "orbicular-obovoid," a characteristic which Mackenzie restricts to *C. abdita*. In our plants the perigynia are not over 3.2 mm. long which puts them at the upper limit of *C. abdita* and at the lower limit of *C. umbellata,* as these are described by Mackenzie (N. A. Fl. 18: 204–205).

C. tonsa (Fernald) Bicknell *cf.* Fernald, Rhodora **44:** 289. Sea Gull Lake, L 3618.—In crevices of rocks.

C. PEDUNCULATA Muhlen. Poplar Lake, D 38.

C. AUREA Nutt. Sea Gull Lake, L 3658; Grand Portage, BA 1025; Temperance River, SS 12040; Schroeder, BA 1062, L 6404, O 985.—Cedar bog, disturbed ground along roadsides and roadside ditch; infrequent.

C. CRINITA Lam. Leo Lake, BR 6336.—Moist woods near lake shore.

C. AQUATILIS Wahl. Grand Marais, F. F. Wood 1, L. S. Cheney (June 29, 1891); Grand Portage, R 7898.—Swampy area.

C. AQUATILIS, var. ALTIOR (Rydb.) Fernald. *C. substricta* (Kükenthal) Mackenzie. South Fowl Lake, L. S. Cheney 40.

C. LENTICULARIS Michx. Loon Lake, L 3720; Moss Lake, D 130; South Fowl Lake, BBsH 297; Morrison Bay, BBs 722; Susie Island, R 6049; Lucille Island, BAA 353; Long Island, AA 532; Grand Marais, BR 4658.—Beaches, moist pockets in rocks, stream banks.

C. STRICTA Lam. Clearwater Lake, BsH 154.—Moist, open portage trail.

C. MEDIA R. Br. *cf.* Fernald, RHODORA **44:** 304. *C. Vahlii* Schkuhr, var. *inferalpina* (Wahlenb.) Fernald, RHODORA **35:** 398. *C. Halleri* of authors. Watab Lake, BA 215; Pigeon Point, BR 6249, BAA 436, BBs 742; Lucille Island, BAA 347, OO 1086; Long Island, AA 550; Grand Marais, BR 4645, BR 4651, Butters and Wherry (June 28, 1935); Carribeau River, BR 4509, BR 4510; Temperance River, B. Juni (1878); Schroeder, BA 1083, L 6434, L 6419.—Moist woods and meadows; occasional. Except for the specimens cited above this species is represented from Minnesota in the Herbarium of the University of Minnesota only from Lake County

While Fernald (RHODORA **35:** 223 and Gray's Manual, ed. 8, p. 344) gives the lower limit of plant size in this as 1.5 dm., some of our specimens are but 1 dm. in height. The granulation of the perigynium in our material is extremely variable and in some cases as great as in *C. norvegica* Retz. (*C. Vahlii*, var. *typica* Fernald). Furthermore the shape of the perigynium varies greatly even in the same plant. In general, however, the perigynium is not sharply triangular in contrast with the Scandinavian material of *C. norvegica* and that has led us to place our material in *C. media.* Unlike *C. media* var. *Steveni* (Holm) Fernald our material has the heads closely approximated.

C. BUXBAUMII Wahl. Sea Gull Lake, L 3644; Little Brick Island, OS 1083; Schroeder, BA 1072.—Lake shore, roadside ditch, and wet soil.

C. LIMOSA L. Grand Marais, L. S. Cheney 31.

C. PAUPERCULA Michx. (typical). Lake Saganaga, F. F. Wood 8; Porcupine Island, AA 577, OO 1018; Susie Island, OO 1024; Long Island, AA 528, OS 1113; Grand Marais, L. S. Cheney 37.—Rocky shores. The typical state of this species is characteristically northern in Minnesota.

C. PAUPERCULA Michx., var. PALLENS Fernald, RHODORA **8:** 77. Sea Gull Lake, L 3658; Birch Lake, BA 827.—Portages and sphagnum bogs.

C. HOUGHTONIANA Torr. *ex* Dewey, Amer. Jour. Sci., ser. 1, 30: 63. 1836. "*C. Houghtonii*" *cf.* Mackenzie, N. A. Fl. 18: 328; Fernald, Gray's

Manual, ed. 8, p. 349. Sea Gull Lake, L 3641, BA 920; Gunflint Lake, F. F. Wood 18; North Lake, D. Lange 3; Poplar Lake, R 5438; Birch Lake, BA 819; MacFarland Lake, BBl 328; North Fowl Lake, BABs 675 & 704; South Fowl Lake, BM 10834; Grand Portage, R 5982, Be 667; Grand Marais, L. S. Cheney 32, BA 763; Carribeau River, BR 4511; Tofte, BR 4468, NBr 3158; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 681.—Hillsides, clearings, roadsides, talus slopes, gravel pits, cliffs; common. The specific epithet as cited above is undoubtedly a valid publication in spite of Torrey's criticism as supported by Mackenzie (*loc. cit.*).

C. lasiocarpa Ehrh., var. americana Fernald, Rhodora **44:** 304. *C. filiformis* of authors. Gunflint Lake, D. Lange (June 28, 1917); Moose Lake, L. S. Cheney 25; Grand Portage, BA 971.—Portage trails, in water along pond and lake shores.

C. gracillima Schw. Grand Portage, BM 10873, BA 1050, SS 12019; Carribeau River, BR 4514.—Moist meadows and portage trails.

C. castanea Wahl. Sea Gull Lake, L 3702.—Portage.

C. arctata Boott. Gunflint Lake, R 5452; Poplar Lake, D 85; Clearwater Lake, BA 71; Mountain Lake, BBsH 64; East Pike Lake, BsH 212; South Fowl Lake, BsH 259; Mount Josephine, NE 2054; Mineral Center, BR 4580; Schroeder, NBr 3196.—Cliffs, talus slopes, portage trails, dry pine woods on hill-tops; general.

C. livida (Wahl.) Willd. Grand Portage, BR 6297A; Schroeder, BA 1059, L 6400, L 6431.—Border of pond in cedar woods, roadside ditch. One other collection from Minnesota (Lake County) is represented in the Herbarium of the University of Minnesota (B. Juni, Gooseberry Point, 1878).

C. vaginata Tausch. *C. saltuensis* L. H. Bailey. Birch Lake, BA 832; Grand Portage, R 6006.—Hummocks of sphagnum in spruce woods.

C. ormostachya Wiegand, Rhodora **24:** 196. Clearwater Lake, BsH 157.—Portage trail in moist soil; rare. Concerning this specimen the late Professor K. M. Wiegand says (*in lit.* Jan. 12, 1939) he "would identify [this] *Carex* as *C. ormostachya.* It agrees in all essential details. In addition to the Eagle Harbor and Porcupine Mts. specimens noted in my paper, I have had one from Douglas Lake. I judge, therefore, that the species occurs more generally than has been supposed around the Lake Superior region and vicinity." First record from Minnesota.

C. leptonervia (Fernald) Fernald, Rhodora **16:** 214. Poplar Lake, D 42; South Fowl Lake, BABs 637; Hovland, BR 4632; Carribeau River, BR 4515.—Moist meadows and woods.

C. flava L., var. fertilis Peck. *C. cryptolepis* Mackenzie. Lake Saganaga, L. S. Cheney 44 (in part); Sea Gull Lake, L 3649; East Bearskin Lake, BBl 475; West Pike Lake, BsH 172; Schroeder, L 6430.—Muddy and rocky lake shores and in swampy ground.

C. viridula Michx. *C. Oederi* Retz., var. *pumila* (Coss. & Germ.) Fernald, Rhodora **8:** 201; *ibid* **35:** 231. Lake Saganaga, L. S. Cheney 44 (in part); Grand Portage, BR 6297.—Pond and lake margins. Achenes

in our material are a little larger than they are in Pl. Exsicc. Gray. No. 168, and ours, in nearly mature examples, tend to have the edges of the achene pale while the rest is darker.

C. PAUCIFLORA Lightf. Sea Gull Lake, L 3696.—Sphagnum bog.

C. HYSTRICINA Muhl. Schroeder, L 3729, BA 1069.—Roadside ditch.

C. MICHAUXIANA Boeckl. Schroeder, BA 1086, L 6401.—Roadside ditch.

C. INTUMESCENS Rudge, var. FERNALDII L. H. Bailey. Sea Gull Lake, L 3672, L 3700; Cross River, BBl 390, BR (Aug. 20, 1934); Poplar Lake, L. W. Orr 18; Partridge Lake, D 189; Rove Lake, BA 105, BBsH 101; Mountain Lake, BAA 272; Lily Lake, BBsH 75; South Fowl Lake, BABs 638; Grand Portage, SS 12021; Mineral Center, BR 4591; Carribeau River, BR 4513.—Moist meadows, along trails, moist thickets; common. Mackenzie (N. A. Fl. 18) does not recognize this northern variety with its more narrowly ovate-lanceolate perigynia as distinct from the "fatter"-fruited southern material. Our specimens, however, definitely are the northern extreme.

C. RETRORSA Schw. Gunflint Lake, BR 6386; Clearwater Lake, BBl 437; Alder Lake, BsH 386; Grand Portage, R 7905; Cascade River, C. B. Reif A 26; Schroeder, OS 990.—Moist shores and banks.

C. RETRORSA, var. ROBINSONII Fernald, RHODORA **8:** 201. Sea Gull Lake, L 3683; South Fowl Lake, BsH 300.—Beaches and streams.

While this variety is ignored by Mackenzie (N. A. Fl. 18), by Kükenthal (Pflznrch. IV. 20), and more recently by Fernald in Gray's Manual, ed. 8 (p. 378), our material fits best in this entity of Maine and Quebec because of the markedly short (*ca.* 5–6 mm. long) and relatively narrow (*ca.* 2 mm. wide) perigynia, and slightly shorter achenes (*ca.* $2\frac{1}{4} \times 1\frac{1}{4}$ mm.) which gives them a less oblong form. The perigynia and achenes have exactly the same texture as typical material of the species. The spikes are 1.3 cm. thick which comes within Fernald's description of the variety. In some plants the spikes are all clustered at the top, while in others a long-peduncled, single basal spike is more remote.

C. ROSTRATA Stokes, var. UTRICULATA (Boott) Bailey. *C. inflata* Huds., var. *utriculata* (Boott) Druce *cf.* Fernald, RHODORA **44:** 329, and RHODORA **48:** 145–146. Lake Saganaga, L. S. Cheney (July 23, 1891); Seagull River, BA 937; Sea Gull Lake, L 3684; Loon Lake, C. B. Reif A27; Mountain Lake, BBsH 91; West Pike Lake, BsH 183; Grand Portage, SS A5307a.—Along streams and in shallow water.

C. VESICARIA L. Loon Lake, BR 6515; South Fowl Lake, BABs 643.—Sloughs and stream beds.

ARACEAE

ARISAEMA ATRORUBENS (Ait.) Blume. *cf.* Fernald, RHODORA **42:** 252. Cross River (near Gunflint Lake), BR 6370; Mountain Lake, BBsH 146; Mineral Center, BR 4586.—Moist woods, including sugar bush; all over the wooded part of the state, but relatively uncommon in Cook County, tending to be associated with other more southern species. Hood of BR 4586 is solid purple.

Calla palustris L. Kelso River, Bg 112; Gunflint Lake, SS 6009; Poplar Lake, Bg (photograph, 1943); Aspen Lake, BA 958; Brule River, BR 4522; Grand Marais, BA 978.—Ponds and marshes; local but usually abundant where it occurs. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) as at Cross River.

Acorus Calamus L. Loon Lake, C. B. Reif A17.—Very scarce. Reported by Smith and Moyle (*loc. cit.*) as at Kadunce Creek.

LEMNACEAE

Lemna minor L. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) as in Kadunce Creek.

ERIOCAULACEAE

Eriocaulon septangulare With. Saganaga Lake, N 1682; Sawbill Lake, Bg 111; Aspen Lake, U. S. F. S. (Sept. 1936); East Bearskin Lake, BBl 474.—Mucky and clayey soil; rare.

JUNCACEAE[12]

Juncus bufonius L. Greenwood Lake, BA 983; Grand Portage, R 5980.—Gravel pit, roadside.

J. tenuis Willd., f. Williamsii (Fern.) Hermann, Castanea 10: 23. Clearwater Lake, BsH 152; Greenwood Lake, BA 985; Thunder Bay Dist., Ont. (Mountain Lake), BAA 313.—Gravel pits, portage trails.

J. tenuis, var. multicornis E. Mey. Seagull Lake, BA 932 (*fide* S. C. W., approaching f. *Williamsii*); Hungry Jack Lake, BR 6344 (*fide* S. C. W.); Mountain Lake, BBsH 92 (*fide* S. C. W.); Grand Portage, Be 486 (*fide* S. C. W.).—Portage trails, gravel pits, dock sides.

J. tenuis, var. Dudleyi (Wieg.) Hermann, Jour. Arn. Arb. 25: 56. (1944). *J. Dudleyi* Wieg. Saganaga Lake, N 1684a (*fide* S. C. W.); Schroeder, BA 1076.—Moist ground.

J. Vaseyi Engelm. Grand Portage, B (Sept. 15, 1929); Tofte, R 7819.—Meadow, edge of thicket; infrequent.

J. filiformis L. Sea Gull Lake, BR 6522; South Fowl Lake, BsH 299.—Rubble beaches, etc.

J. effusus L., var. decipiens Buchen. *cf.* Fernald & Wiegand, Rhodora **12:** 87. Hungry Jack Lake, BR 6343a.—Lake shore. This is the first record from the state in the Herbarium of the University of Minnesota.

J. effusus, var. Pylaei (Laharpe) Fernald & Wiegand, Rhodora **12:** 92. Lake Saganaga, BA 934; Cross River, BR 6376; Hungry Jack Lake, BR 6343b.—Wet river banks and lake shores.

J. nodosus L. Schroeder, BA 1081, OO 996.—Roadside ditch. Reported from Kadunce Creek by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134).

J. brevicaudatus (Engelm.) Fernald, Rhodora **6:** 35. Sea Gull Lake, BA 921; Loon Lake, BR 6520; Poplar Lake, R 5445; Hungry Jack Lake,

[12] Mr. S. C. Wadmond has kindly checked each of these identifications (with the exception of R 7819). His changes in determinations are indicated as "fide S. C. W."

BR 6348, BR 6351; Leo Lake, BR 6340; Greenwood Lake, BA 982; Porcupine Island, BR 6243, OO 1052; Susie Island, R 6050; Long Island, AA 530, AA 531; Grand Portage, BR 6295; Grand Marais, R 5961a; Lutsen, BR 6862; Schroeder, BA 1070, BA 1075 (*fide* S. C. W.), O 987.—Pond margins, stream beds, etc.; abundant. BR 6295 has rather long, narrow fruits which look somewhat unlike the majority of specimens.

J. ALPINUS Vill., var. RARIFLORUS Hartm. Greenwood Lake, BA 984.—Gravel pit.

J. PELOCARPUS Mey. Saganaga Lake, N 1684.—Wet, clay soil. The specimen is viviparous in part, as is often the case in this species.

LUZULA ACUMINATA Raf. *L. saltuensis* Fernald. Tucker Lake, D 185; Pigeon River, BR 4614.—Low moist places.

L. PARVIFLORA (Ehrh.) Desv. *L. parviflora*, var. *melanocarpa* (Michx.) Buchenau. Grand Marais, L. S. Cheney (July 26, 1891) Caribou Lake L 7247.—These appear to be the only collections from Minnesota, except for one made by Lakela (no. 4622) near Little Marais in nearby Lake County.

L. MULTIFOLRA (Retz.) Lej. Loon Lake, D 164.—Roadside.

LILIACEAE

TOFIELDIA PUSILLA (Michx.) Pers. *T. palustris* Gray's Man. ed. 7. Grand Marais, L. S. Cheney (July 20, 1891), BR 4642, N. L. Huff (July 9, 1925).—On moist rocks near lake shore. It is otherwise represented from Minnesota in the Herbarium of the University of Minnesota only from Two Harbors where it was collected by J. H. Sandberg, July 1891.

ALLIUM STELLATUM Fraser. Schroeder, BA 1079, BA 1079a.—Road cut. BA 1079a is a teratological form in which the flower is whitish, the pistil replaced by a vegetative bud.

A. SCHOENOPRASUM L., var. SIBIRICUM (L.) Hartm. *cf.* Fernald, RHODORA **28:** 167. Pigeon Point, BR 6278; Clark's Bay, BAA 411; Susie Island, OS 1033, OO 1120; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 690.—Cliffs and sterile slopes and basaltic ledges; rare.

The collections listed above and material from Isle Royale, Mich., Lake and Carleton Cos. Minn., are more or less intermediate between *A. Schoenoprasum*, var. *sibiricum* and *A. Schoenoprasum* var. *laurentianum* Fernald (*loc. cit.*) as Fernald characterizes these two varieties. Fernald describes the perianth as 10–14 mm. long in var. *sibiricum* and 8–10 mm. long in var. *laurentianum*,—ours being 7.5–12 mm.; the perianth segments of var. *sibiricum* "usually—more attenuate," of var. *laurentianum* as "less attenuate,"—ours are more or less attenuate!; the color of the perianth in var. *sibiricum* as "commonly paler (though sometimes intensely colored)," in var. *laurentianum* as "intensely colored,"—ours are intensely colored. Fernald distinguishes between the two varieties also with respect to the width of umbel which he describes in var. *sibiricum* as 3.5–5 cm. in diam. in well-developed flowering specimens, and as 2.3–3 (rarely –3.3) cm. in var. *laurentianum*—ours range from 2.8 to 3.6 cm. and average ca. 3.2 cm. Our material seems effectually to fill the gap

between the older variety and the newer one, and we are therefore applying to it the name of the older variety whose concept should perhaps be emended to include var. *laurentianum*.

Lilium philadelphicum L., var. andinum (Nutt.) Ker. Long Island, BAA 465, AA 506; OS 1116; Grand Portage, BA 207; Mount Josephine, NE 2326; Temperance River, SS 6037; Thunder Bay Dist., Ont. (North Fowl Lake) BABs 695.—Open wooded areas and open rocky areas; local and rare.

There is much variation in the material from Long Island (BAA 465), both in color of the perianth which ranges from dark red to orange, as well as in the width of the perianth segments. This is rather significant because the population is a very small one on this island and it would be expected that if it had survived *in situ* for any large number of generations it would have achieved a higher degree of homozygosity than seems to be expressed morphologically. NE 2326 resembles typical material in its broader leaves which are present in two whorls instead of one.

Clintonia borealis (Ait.) Raf. Sea Gull Lake, L 3620; Poplar Lake, L. W. Orr 10, L. W. Orr 24, D 14, D 75; South Fowl Lake, BABs 626; Clark's Bay, BBs 717; Grand Portage, Be 488, S. Brown 14.—In birch, spruce and jack pine woods; ubiquitous.

Smilacina racemosa (L.) Desf. Mineral Center, BR 4587.—Sugar bush; rare.

S. trifolia (L.) Desf. Sea Gull Lake, L 3662 & 3670; Poplar Lake, D 64; Caribou Lake, BA 130; Pigeon River, BR 4556; Grand Portage, R 6004, Be 690, S. Brown 40, BA 972; Brule River, L. S. Cheney (July 2, 1891).—In sphagnum of cedar bogs, spruce woods and tamarack woods; locally abundant.

Maianthemum canadense Desf. (typical). Sea Gull Lake, L 3611; Tucker Lake, D 183; Poplar Lake, L. W. Orr 12, L. W. Orr 23, E. Loula 22, D 53; South Fowl Lake, BABs 617; Pigeon Point, BAA 438; Clark's Bay, BBs 718; Morrison Bay, BBl 362; Grand Portage, Be 529 & 699, R 6013, Butters & Wherry (June 30, 1935), S. Brown (1935), BA 208; Brule River, BR 4551; Grand Marais, L. S. Cheney (June 20, 1891); Carribeau River, BR 4507.—Trails, coniferous woods, etc.; general.

M. canadense, var. interius Fernald, Rhodora **16:** 211. *cf.* also Butters, Minn. Studies Pl. Sci. 1: 437. Mineral Center, BR 4594, BA 192.—Hard maple forest—this is the only locality in which this variety has been found in Cook County.

Streptopus amplexifolius (L.) DC., var. americanus Schultes. *cf.* Fassett, Rhodora **37:** 98. Kimball Creek, R 2616; Carribeau River, BR 4498.—Shady places; infrequent.

S. amplexifolius, var. denticulatus Fassett, Rhodora **37:** 98. Mountain Lake, BBsH 138; Grand Portage, Be 537, Be 635; Temperance River, L 4793.—Moist woods; infrequent.

S. roseus Michx., var. longipes (Fern.) Fassett, Rhodora **37:** 110. Sawbill Lake, Bg 109; Poplar Lake, L. W. Orr 1, BA 824; Clearwater Lake, BBl 420; Clark's Bay, BBs 715; Grand Portage, Be 556, S. Brown 5;

Grand Marais, F. F. Wood (June 20, 1891), L. S. Cheney (June 20, 1891).—Moist woods, birch, birch-aspen, etc.; ubiquitous.

Polygonatum pubescens (Willd.) Pursh. Mineral Center, BR 4592, BA 191.—Hard maple forest, the only locality in Cook Co. where this species has been found.

Trillium cernuum L., var. macranthum Wieg. Sawbill Lake, Bg 110; Poplar Lake, D 24, D 68; South Fowl Lake, BABs 635; Pigeon River, BR 4617; Grand Portage, S. Brown 11; Mineral Center, BA 218.—Tends to occur in hardwood forest; rare. Mr. D. M. Stewart reports "*T. cernuum*" from just west of Lima Mountain.

IRIDACEAE

Sisyrinchium montanum Greene, var. crebrum Fernald, Rhodora **48:** 159. *S. angustifolium* of Gray's Man., ed. 7. Clearwater Lake, D 110; Clark's Bay, BAA 410; Grand Portage, Be 472, BBl 363, Butters & Wherry (June 30, 1935), S. Brown 19, BA 206, BA 1028, SS 12018a; Grand Marais, L. S. Cheney (June 27, 1891); Schroeder, BA 1077, OS 989.—Sterile slopes, road banks, old roads, meadows; infrequent. BBl 363 has inflorescences which branch in two of the seven plants collected. This character as well as the darker color of the dried plants suggests *S. angustifolium* Mill. (there is a tendency for *S. angustifolium* to brown slightly on drying as contrasted with the usually fresh-looking green of *S. montanum* var. *crebrum*). Its spathes, on the other hand, are quite definitely like *S. montanum* var. *crebrum*. Since Miss Lakela has found material (L 5353) in Duluth which very closely resembles (except that the seeds are not quite spherical) *S. angustifolium*, it is not impossible that *S. angustifolium* occurs elsewhere on the shores of Lake Superior and thus may have hybridized with the ubiquitous *S. montanum* var. *crebrum* to produce the occasional intermediate type of individual represented by BBl 363. Perhaps the fact that the seeds of BBl 363 are abortive lends further support to this conjecture.

Iris versicolor L. Sea Gull Lake, L 3634; Sawbill Lake, Bg 108; Round Lake, C. B. Reif A9; Gunflint Lake, BBl 382; Lily Lake, BBsH 73; South Fowl Lake, BABs 632; Pigeon Point, N 1642; Little Brick Island, OS 1082; Susie Island, R 6032b; Grand Portage, S. Brown 29; Brule River, C. B. Reif (July 10, 1936); Temperance River, C. B. Reif A12; Thunder Bay Dist., Ont. (Mountain Lake), BAA 323a.—Lake shores, moist woods, swales; general, but not very abundant. Reported from Cross River by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134).

ORCHIDACEAE

Cypripedium arietinum R. Br. Gunflint Lake, Holzinger (June 17, 1897).—Very rare.

C. Calceolus L., var. parviflorum (Salisb.) Fernald, Rhodora **48:** 4. *C. parviflorum* Salisb. Sea Gull Lake, L 3660.—Cedar bog; very rare; not indicated by Fuller (Bull. Publ. Mus. City of Milwaukee 14: 67) as seen from Cook Co. or the Arrowhead country in general.

C. acaule Ait. Sea Gull Lake, L 3621; Poplar Lake, BA 211; Partridge Lake, D 188; Clearwater Lake, N 1698; Wauswaugoning Bay, NE 2324; Brule River, BR 4504.—Abundant.

Habenaria viridis (L.) R. Br., var. bracteata (Muhl.) A. Gray. North Fowl Lake, BABs 662; Pigeon River, BR 4621; Grand Portage, Be 523, Be 559, R 6069, S. Brown 34, BM 10872, BA 1021; Mount Josephine, NE 2331, BA 180; Carlton Peak, T. S. Roberts (Aug. 25, 1879).—Old trails, shady woods, roadsides; general.

H. hyperborea (L.) R. Br., var. huronensis (Nutt.) Farw. Sea Gull Lake, L 3651; Grand Portage, BA 217, S. Brown (1937), R 7892; Tofte, L 4701, R 7826; Cross River (?), L 3722; Temperance River, SS 6070.—Sphagnous cedar bogs, swampy roadsides, moist ditches; infrequent. This is not reported from Cook County by Fuller (*op. cit.*, p. 85).

H. dilatata (Pursh) Hook. Alton Lake, Winslow Briggs (Sept. 8, 1951); Grand Portage, BM 10875.—Spruce-tamarack and cedar swamps; rare. Not reported from Cook Co. by Fuller (*op. cit.*, p. 86.).

H. Hookeri Torr. Sawbill Lake, Bg 102; Sea Gull Lake, L 3622, L 3679, Winslow Briggs (Sept. 8, 1951); Granite River, L. S. Cheney (Jul. 22, 1891); Birch Lake, D 61; Tucker Lake, D 182; South Lake, D 780.—Moist woods; occasional.

H. orbiculata (Pursh) Torr. Sea Gull Lake, L 3661; Sawbill Lake, Bg 98; Poplar Lake, L. W. Orr 2; Partridge Lake, BA 778; Rove Lake, F. F. Wood (Jul. 13, 1891); Mineral Center, BR 4584; Devil's Track River, T. S. Roberts (Aug. 21, 1879).—Moist woods; occasional.

H. obtusata (Pursh) Richards. Sea Gull Lake, L 3625; Sawbill Lake, Bg 100; Gunflint Lake, L 3719, SS 6012; Birch Lake, BA 777; Royal Lake, BM 10858; Pigeon River, BR 4555; Susie Island, OO 1135; Grand Portage, L. S. Cheney (July 4, 1891), R 5985, S. Brown 32, BM 10877; Hovland, Be 619; Devil's Track River, C. W. Hall (Aug. 21, 1879); Grand Marais, T. S. Roberts (Jul. 30, 1879), MacMillan Brand & Lyon 49, N. L. Huff (Jul. 10, 1925), BA 769.—Moist woods; common.

H. psycodes (L.) Spreng. Jasper Lake, Winslow Briggs (Sept. 8, 1951).—Portage; rare. Winslow Briggs also reports this as seen Aug. 28, 1950 on the portage between Mueller Lake and Ogishke Muncie Lake in Lake County.

Pogonia ophioglossoides (L.) Ker. Sawbill Lake, Bg 106.—Rare—first record in Herbarium of the University of Minnesota from Cook County.

Arethusa bulbosa L. Kelso River, Bg (Jul. 2, 1946).—Rare—first record in the Herbarium of the University of Minnesota from Cook County.

Spiranthes gracilis (Bigel.) Beck. Sea Gull Lake, BA 917; Sawbill Lake, Bg 107; Otter Lake, BA 793; Lima Mountain, BA 861; Grand Marais, BA 770.—Pine woods and mixed woods; infrequent.

S. Romanzoffiana Cham. Sawbill Lake, Bg 104; Kelso Mountain, Bg 105; Grand Portage, BR 6292, S A5302; Tofte, R 7827, R 7848.—Cedar swamp, roadside; rare.

Not shown from Cook Co. by Fuller (*op. cit.*, p. 114).

GOODYERA REPENS (L.) R. Br., var. OPHIOIDES Fernald. Sawbill Lake, Bg 11, Bg 101; Birch Lake, BA 831a; Rove Lake, L. S. Cheney (July 16, 1891), BBl 424; Clearwater Lake, BBl 457; Mountain Lake, BBsH 142; Pigeon Point, S 6008; Clark's Bay, BR 6224, N 1618, AA 584a; Susie Island, R 6059, OO 1020; Lucille Island, BAA 372; Grand Portage, R 6009, BA 977; Grand Marais, T. S. Roberts (Jul. 30, 1879), MacMillan Brand & Lyon 50, H. L. Lyon 920, H. L. Lyon 935, BA 771; Temperance River, OO 998; Cascade River, T. S. Roberts (Aug. 2, 1879).—Moist woods; common.

G. TESSELATA Lodd. Sea Gull Lake, L 3623, Winslow Briggs (Sept. 8, 1951); Gunflint Lake, BR (Aug. 1934); Birch Lake, BA 831; Lima Mountain, BA 863; Royal Lake, BM 10856.—Moist woods; infrequent. L 3623 is too young for accurate determination, but probably belongs here.

LISTERA CORDATA (L.) R. Br. Sawbill Lake, Bg 9, Bg 10; Sea Gull Lake, L 3663; Gunflint Lake, L 3718, SS 6011; Royal Lake, BM 10857; Pigeon River, BR 4554; Clark's Bay, BBs 719; Susie Island, R 6060, OO 1134; Lucille Island, BAA 353; Grand Portage, S. Brown 33, BM 10876; Reservation River, L. S. Cheney (Jul. 4, 1891).—Moist woods; occasional.

L. AURICULATA Wiegand. Grand Portage, R 6026b; Grand Marais, L. S. Cheney (Jul. 23, 1891).—Moist woods; very scarce—these are the only records for Minnesota other than for Duluth (Lakela 6010).

L. CONVALLARIOIDES (Sw.) Nutt. Mineral Center, BR 4576.—Cedar-spruce-balsam forest; very scarce. Immature; only record for Minnesota in the University of Minnesota Herbarium.

CORALLORHIZA TRIFIDA Chatel. Sea Gull Lake, L 3659; Sawbill Lake, Bg 8; Gunflint Lake, SS 6016; North Lake, D. Lange 7; Poplar Lake, D 52, D 52a; Tucker Lake, D 179; Moss Lake, D 133; Clearwater Lake, BA 91, D 124; Mountain Lake, BBsH 147; John Lake, BM 10805; MacFarland Lake, BBl 342; North Fowl Lake, BABs 663; Royal Lake, BM 10854; Pigeon River, BR 4620; Grand Portage, Butters & Wherry (June 29, 1935); Carribeau River, BR 4512.—Moist woods; very common.

C. MACULATA Raf. Sea Gull Lake, L 3624; Sawbill Lake, Bg 7, Bg 106; Gunflint Lake, BBl 386, L 3716; Watab Lake, BAA 315, BBsH 15; Clearwater Lake, BA 122; Mountain Lake, BAA 309; John Lake, BM 10780; Clark's Bay, NE 2330; Susie Island, OO 1133; Grand Portage, BBl 345, S. Brown 26 & 35; Mount Josephine, NE 2327, BA 173; Mineral Center, BR 4600.—Moist woods; common.

C. MACULATA, f. FLAVIDA (Peck) Farwell. Poplar Lake, Bg (photograph, 1943); Mountain Lake, BAA 264; Temperance River, SS 6069.—Spruce-birch woods; infrequent. Flowers waxy-yellow with white lip.

C. STRIATA Lindl. Mount Josephine, NE 2329, S. Brown (1935).—Moist woods; more common than the number of collections would indicate. It is not cited from Cook County by Fuller (*op. cit.*, p. 139).

MICROSTYLIS UNIFOLIA (Michx.) B. S. P. *Malaxis unifolia* Michx. Kelso Mountain, Bg 103; Grand Portage, BM 10883; Tofte, L 4700; Temperance River, OS 1000; Schroeder, BA 1064.—Slate slopes, roadside ditch, grassy hill top; rare. While this species is often included in the

genus *Malaxis*, it has the ovaries of the flowers twisted only 180°, while in *Malaxis* proper the ovaries are twisted 360°. This would seem to justify maintaining the genera as distinct. Not recorded from Cook Co. by Fuller (*op. cit.*, p. 126).

Liparis Loeselii (L.) Richard. Schroeder, BA 1074.—Roadside ditch; very rare. First record in University of Minnesota Herbarium for Cook County.

Calypso bulbosa (L.) Oakes. Sea Gull Lake, Jim Dunn (L 3680); South Lake, BA 782, D 190; Black Point, T. S. Roberts (Aug. 24, 1879).—Mossy woods; very rare.

SALICACEAE

Salix pyrifolia Anderss. Sea Gull Lake, N 1669, N 1675, Poplar Lake, R 5436, D 2, D 30, D 79, D 81; Birch Lake, D 73; Moss Lake, D 131; South Fowl Lake, BABs 642; Sailboat Island, AA 536a; Grand Portage, BR 6308; Grand Marais, Butters & Wherry (June 28, 1935), BA 41.—Sloughs, pond margins, jack pine woods; common.

S. Bebbiana Sarg. Poplar Lake, D 82; Loon Lake, D 170, D 171, D 174, D 177, D 178; South Fowl Lake, BABs 651; Porcupine Island, AA 578; Sailboat Island, AA 536; Grand Portage, Be 471; Kimball Creek, R 2636; Grand Marais, BA 36, BR 6908, BM 10763, BM 10777; Tofte, BR 4475.—Beaches, old trails and roads.

S. pedicellaris Pursh, var. hypoglauca Fernald. Sea Gull Lake, BA 905; Brule River, H. F. Olson 2.—Muskeg and wet meadow; infrequent.

S. discolor Muhl. Poplar Lake, D 11, D 21, D 39, D 44, D 67a; Grand Portage, R 6005, Be 610, Be 676, R 6023, R 7890, R 7891; Grand Marais, BM 10764.—Swamp margins, moist trails, pond margins; common.

S. discolor, var. latifolia Anderss. *S. dicolor*, var. *eriocephala* of Gray's Man., ed. 7. Grand Portage, R 6012, R 6015; Mount Josephine, BR 6313, BR 6315; Grand Marais, BA 45.—Roadsides, hill tops.

S. humilis Marsh. Poplar Lake, L. W. Orr 30; Grand Portage, Be 547; Mount Josephine, BR 6314.—Portage trail, hill top.

S. gracilis Anderss. *S. petiolaris* J. E. Smith, var. *rosmarinoides* (Anderss.) Schneid. South Fowl Lake, BABs 648.—Beach.

S. planifolia Pursh. Poplar Lake, D 78, D 80; Clark's Bay BR 6230; Porcupine Island, BR 6242; Susie Island, R 6048; Grand Portage, Be 651, Be 691, R 6021, BA 969; Brule River, BR 4521; Grand Marais, R 5967, BA 35, BA 43, BA 44, BR 6907, BR 6909.—Edge of woods by ponds and swamps, lake margin; infrequent. This species occurs in St. Louis, Lake of the Woods and Cook Counties in Minnesota as far as the collections in the Herbarium of the University of Minnesota would indicate.

S. Bebbiana × S. planifolia. Porcupine Island, BBs 744.—Crack in shore rocks. Both of the presumed parents grow on this island. This collection has pistils and fruits with the short styles of *S. Bebbiana;* the very young, as yet unfolded leaves have the dense pubescence of similar leaves of *S. Bebbiana;* very young leaves which have just unfolded are

reddish and rapidly become glabrescent like those of *S. planifolia;* the old leaves are not quite rugose enough for *S. Bebbiana.*

S. PELLITA Anderss. Grand Portage, BA 993.—Brookside thicket. Not previously represented from Minnesota in the Herbarium of the University of Minnesota, although it has been collected on Isle Royale by W. S. Cooper.

POPULUS TREMULOIDES Michx. Grand Portage, Be 527, Be 545.—Occurring sporadically throughout the county, especially in old burns and openings.

P. BALSAMIFERA L. Grand Portage, Be 468, Be 648.—Forming groves in various parts of the county, especially in the southern half where it is quite general.

MYRICACEAE

MYRICA GALE L. Sea Gull Lake, L 3606; Gunflint Lake, BR 6380; Poplar Lake, D 109; Birch Lake, D 72; Otter Lake, BA 795; South Fowl Lake, BABs 650; Clark's Bay, NBr 3218; Susie Island, R 6047, N 1654; Grand Portage, Be 704, BR 6306; Brule River, BR 4520; Temperance River, L 4711.—Bogs, beaches, lake shore; common to very abundant, although absent from some lake shores, while it may form a veritable hedge around others.

COMPTONIA PEREGRINA (L.) Coult. *cf.* RHODORA **40:** 410. *Myrica asplenifolia* L.—We have not noted this species to date in Cook Co., although it is abundant in Lake and St. Louis counties immediately to the west. It is to be expected in the acidic portions of Cook Co.

CORYLACEAE

CORYLUS CORNUTA Marsh. Cross River, BBl 391; Grand Portage, Be 503; Mineral Center, Be 639; Grand Marais, R 2604; F. H. Anderson (1938); Thunder Bay Dist., Ont. (north side of Mountain Lake), BAA 311.—Forming thickets in white birch-black ash woods and *Pinus resinosa* forest.

BETULA LUTEA Michx. f. Mineral Center, Be 638.—Large trees in the isolated sugar-bush, mentioned in more detail under *Acer saccharum.* Also observed by BA at Mineral Center, and reported by D. M. Stewart near Hovland.

B. PAPYRIFERA Marsh. Poplar Lake, R 5441, BR (Aug. 26, 1934); Pigeon Point, B (Sept. 3, 1927); Lucille Island, BAA 374; Grand Portage, BR 6261, BR 6262.—In spruce woods; abundant. The bark of BR 6261 is somewhat yellowish, but it is otherwise typical of the species.

B. CORDIFOLIA Regel. *cf.* C. O. Rosendahl, Jour. For. 26: 878. *B. papyrifera*, var. *cordifolia* (Regel) Fern. Poplar Lake, R 5440; Porcupine Island, BR 6260; Belle Rose Island, BR 6239; Susie Island, R 6041; Lucille Island, N 1653, BAA 357; Grand Portage, Be 485, Be 572, Be 587, Be 649, SS 12018; Devil's Track River, BR 4639; Grand Marais, R 2619; Schroeder, D. G. Schaal (Sept. 1938). This species in Minnesota is largely restricted to Cook Co.

Betula × Rosendahlii, hybr. nov.—*B. papyrifera* Marsh. × *B. cordifolia* Regel.

Arbor parva (ad 8 m. alta). Cortex fusco-albus vel brunneus, papyraceus vel asper. Rami obscure fusci vel nigri, ramuli juniores obscure luteo-rubri, dense glandulosi, minute villosuli. Foliarum laminae ovatae, basi cuneatae, apice acutae vel acuminatae, margines serrati vel biserrati, 5–7-costatae, supra glabrescentes et glandulosae, et in nervorum axillis pubescentes; petioli glabrescentes et glandulosi, 5–13 mm. longi. Inflorescentiae fructiferae cylindricae, 15–25 mm. longae, 5–8 mm. diam.; bracteae marginibus puberulis, lobo medio oblongo, lanceolato, obtuso, lobis lateralibus brevioribus, angulato-suborbicularibus. Nuculae late obovatae, apice puberulae, alatae, alae corporem in latitudinem aequantes, steriles.

Small tree (up to 8 m. tall), bark dull reddish white to very dark, papery to rough. Branchlets dull grayish to black, twigs dull yellowish-red, densely glandular, minutely villous. Leaf blades ovate, cuneate at the base, acute to acuminate at the apex, margins serrate to bi-serrate, 16–40 mm. wide × 30–55 mm. long, 5–7 lateral veins, glabrescent and glandular above, slightly pubescent and glandular beneath with some pubescence in the axils of the vein branches; the glabrescent and glandular petioles 5–13 mm. long. Pistillate catkins cylindrical 15–25 mm. long, 5–8 mm. diam.; bracts with puberulous margins, the central lobe oblong lanceolate obtuse, lateral lobes shorter and angular suborbicular. Achenes broadly obovate, puberulous at apex, with wings as wide as the body of the nutlet, sterile. Type, *C. O. Rosendahl 6020*, Aug. 12, 1929, bark reddish. On the rocks south side of Grand Portage Island, Cook County, Minnesota (in Herb. Minn.). Other specimens seen (all in Herb. Minn.): *Butters, Abbe & Abbe 439*, July 13, 1937, bark dark and rough, tree about 20 feet high. Shingly beach, Little Portage Bay, Pigeon Point, Cook County, Minn. *Butters & Moore 10865*, July 4, 1939, hill back of Grand Portage, Cook Co., Minn.

In Cook County the ranges of *B. papyrifera* and of *B. cordifolia* overlap, providing an opportunity for hybridization in a genus notorious for this phenomenon (*cf.*, *inter alia*, C. O. Rosendahl, Observations on Betula in Minnesota with special reference to some natural hybrids. Minn. Bot. Stud. 4: 443–459). The rather small-leaved birch described above is intermediate in a number of respects between the putative parents as represented in Cook County. Its leaves are rather densely glandular, as in *B. cordifolia*, rather than sparsely so, as in *B. papyrifera*. The base of the leaf on the other hand approaches the obtusely cuneate character of *B. papyrifera*, rather than the cordate to truncate type of base found in *B. cordifolia*. It resembles neither in the surprisingly microphyllous leaf. The central lobe of the pistillate scale is oblong-lanceolate, while that of *B. cordifolia* is oblong and that of *B. papyrifera* is more nearly acuminate; the lateral lobes are angular-suborbicular, while they are rounded in *B. papyrifera* and strongly ascending and narrowly triangular oblong in *B. cordifolia*. The poorly filled-out achenes are obovate, in contrast to their more or less elliptic outline in the two parental species; and the wings are of about the same width as the body of the achene, while in the parental species the wings are wider than in the hybrid. The bark is quite variable but tends to be darker than in the parental species.

B. pumila L., var. glandulifera Regel. Seagull Lake, BA 904; Kelso River, Bg 97, Bg 99, Bg (Sept. 1, 1946).—Muskeg, and floating

bog; locally abundant in the region of acid rocks, but never observed by us in the Rove slate area.

ALNUS CRISPA (Ait.) Pursh. Sea Gull Lake, L 3619; Sawbill Creek, D. G. Schaal (8–6–38); Poplar Lake, R 5442, D 1, D 84; Mountain Lake, BAA 276; North Fowl Lake, BABs 665; Pigeon Point, R 6070; Morrison's Bay, BBs 736; Lucille Island, BAA 375; Hat Point, Butters & Wherry (Jun. 30, 1935); Grand Portage, Be 553, Be 626; Brule River, BR 4544; Grand Marais, T. S. Roberts (Aug. 14, 1879), R 5970, BA 46; Carribeau River, BR 4486.—Common throughout the County.

A. RUGOSA (DuRoi) Spreng., var. AMERICANA (Regel) Fernald, RHODORA **47:** 333. *A. incana* of Gray's Man., ed. 7. Pigeon Point, BR (Aug. 19, 1930); Grand Portage, Be 494; Schroeder, D. G. Schaal (10–14–38); Thunder Bay Dist., Ont. (Mountain Lake), BAA 324a.

BAA 324a is a microphyllous phase.

URTICACEAE

URTICA PROCERA Muhl. *U. gracilis* of Gray's Man., ed. 7. *cf.* Fernald, RHODORA **28:** 195. Little Caribou Lake, BsH 415; Grand Portage, Be 683.—Cliffs and shore of Lake Superior.

SANTALACEAE

GEOCAULON LIVIDUM (Richards.) Fernald, RHODORA **30:** 23. Pigeon River, BR 4560; Pigeon Point, BBl 731; island north of Little Susie Island, OO 1153; Sailboat Island, OO 1096; Grand Portage, R 6003.—In moss and sphagnum of cedar-spruce swamps; local and rare. The only other collections from the state represented in the Herbarium of the University of Minnesota were made by John W. and Marjorie F. Moore (10923) and by Elenore Colson (10983) in Lake of the Woods County in July, 1939.

ARISTOLOCHIACEAE

ASARUM CANADENSE L., var. ACUMINATUM Ashe. Cross River (near Sea Gull Lake), BBl 388; Pigeon River, BR 4619; Hovland, BR 4630; Kimball Creek, R 2618.

Predominantly southern in Minnesota, and spotty in its occurrence in the northern counties. Typical *A. canadense* occurs much less frequently than does var. *acuminatum*.

POLYGONACEAE

RUMEX MEXICANUS Meisn. Sawbill Trail, Bg 87.—Roadside.

R. CRISPUS L. John Lake, BsH 264.—Portage trail; general weed in Minnesota.

R. ACETOSELLA L. Grand Portage, Be 526, Be 615; Susie Island, OO 1040; Mount Josephine, NE 2052; Grand Marais, T. S. Roberts (Aug. 13, 1879).—Roadsides, etc.; common weed in the state.

POLYGONUM ERECTUM L. Clearwater Lake, BsH 425.—On a road; weed.

P. achoreum Blake, Rhodora **19:** 232. Grand Marais, H. W. Slack (July 1892).

P. aviculare L. Grand Portage, Be 633; Grand Marais, T. S. Roberts (Aug. 13, 1879).—Cultivated ground; roadsides.

P. Douglasii Greene. Clearwater Lake, N 1709.—On ledge of cliff. Fernald (Rhodora **37:** 259) reports this species from Manitoulin Island, Ont., and Keweenaw Co., Mich. and says of its distribution "Local east of the Black Hills and the Rocky Mts. Already known from a few stations in Ontario and in Michigan from the islands of Lake Superior." It is primarily a western species represented in the Herbarium of the University of Minnesota from the Pacific Coast, the Rocky Mountains to Colorado, the Black Hills, Vermont (Eggleston), and in Minnesota from Lake of the Woods, St. Louis, Lake and Cook Counties.

P. viviparum L. Pigeon Point, BBl 361, BAA 437; Belle Rose Island, OO 1071; Lucille Island, BAA 346, OO 1089; Grand Marais, T. S. Roberts (Aug. 21, 1879), L. S. Cheney (June 27, 1891), Butters & Wherry (June 28, 1935).—Crevices of rocks near the shores of Lake Superior; rare. The specimens listed above are the only ones from the state represented in the Herbarium of the University of Minnesota.

P. natans (Michx.) Eaton, f. genuinum Stanford, Rhodora **27:** 158. Sea Gull Lake, N 1666; Granite River, L. S. Cheney (Jul. 21, 1891), F. F. Wood (Jul. 21, 1891); Brule River, E. Loula 18.—Occurring primarily on muddy bottom of which there is little in Cook Co., and is therefore correspondingly infrequent; otherwise general in the state.

P. natans, f. Hartwrightii (Gray) Stanford. *P. amphibium* L., var. *stipulaceum* (Coleman) Fernald. Sea Gull Lake, N 1666a.

P. lapathifolium L. Sawbill Lake, Bg 89.

P. scabrum Moench. Susie Island, OO 1027.—Edge of woods in wet soil among rocks.

P. Hydropiper L. Mineral Center, Be 640; Grand Portage, R 7906.—Hillside and moist roadside; weed. Be 640 is apparently the typical variety (the European weed) which Stanford (*loc. cit.*) gives as occurring in the East and in the West but not in the Middle West.

P. Persicaria L. Grand Marais, T. S. Roberts (Aug. 12, 1879).

P. cilinode Michx. Sea Gull Lake, L 3703; Winchell Lake, BA 138; West Bearskin Lake, D 145; John Lake, BM 10788; North Fowl Lake, BABs 657; Grand Portage, Be 621; Mineral Center, BR 4566; Grand Marais, T. S. Roberts (Jul. 31, 1879); Sawbill Trail, Bg 88.—Cliffs, ridges, thickets; very common.

P. Convolvulus L. Grand Portage, Be 562, Be 616; Grand Marais, T. S. Roberts (Aug. 13, 1879).—Cultivated ground, etc.

CHENOPODIACEAE

Chenopodium hybridum L., var. gigantospermum (Aellen) Rouleau. Cross River, BA 927; Hungry Jack Lake, BsH 423; Rove Lake, BBsH 107; Watab Lake, BAA 234; Clearwater Lake, N 1693, BA 953; Mountain Lake, BBsH 44; West Pike Lake, BsH 176; East Pike Lake, BsH 230;

MacFarland Lake, BsH 373; Royal River, BsH 349; Royal Lake, BsH 249; Thunder Bay Dist., Ont. (Pigeon Bay), AA 603.—Native and general in the region.

C. ALBUM L. Clearwater Lake, N 1713, BA 952; Mountain Lake, BBsH 41; Grand Portage, Be 515, Be 687; Grand Marais, T. S. Roberts (Aug. 13, 1879).—Introduced weed.

C. CAPITATUM (L.) Aschers. Kimball Creek, BR 4662.—Roadside.

AIZOACEAE

MOLLUGO VERTICILLATA L. Poplar Lake, BA 835.—Introduced weed near habitations.

CARYOPHYLLACEAE

SAGINA NODOSA (L.) Fenzl. Pigeon Point, BR 6253, BAA 385, BAA 440, BBs 738; Susie Island, B (Sept. 2, 1927), OO 1151; Thunder Bay Dist., Ont. (the Boundary Islands, Pigeon Bay) AA 595.—Cracks in wave-washed shore rocks of Lake Superior; rare.

While this has long been known from Isle Royale and Isle St. Ignace, it has been represented from Minnesota in the Herbarium of the University of Minnesota only since it was collected in 1927 by the senior author on Susie Island near Grand Portage. It is decidedly local and seems to be wholly restricted to rocks constantly kept moist by the wash of the cold waters of Lake Superior.

ARENARIA MACROPHYLLA Hook. Rove Lake, BBsH 97; Watab Lake, BAA 325; Clearwater Lake, BsH 169; Mountain Lake, BBsH 87; South Fowl Lake, BsH 278; Royal River, BsH 357; Royal Lake, BsH 243, BM 10846; Thunder Bay District., Ont. (South Fowl Lake) BABs 710.—Cliffs and shoulders of cliffs; very local.

This was first collected in Minnesota by Mrs. Abbe and the writers in 1937 (Watab Lake), and was subsequently found in a number of localities in Cook County. It is the broad-leaved extreme, resembling some of the well-developed western material in the Herbarium of the University of Minnesota. It is an excellent match for Hooker, Flor. Bor. Amer., Pl. XXXVII, fig. B, especially in leaf-form (Hooker's var. β). While it is apparently a characteristic serpentine plant in the East and possibly so in the West, in Cook County it occurs primarily on the parched and loose soil of the disintegrating diabase of the diabase caps over the sedimentaries which together form the characterisitc cliffs of northeastern Cook County.

STELLARIA MEDIA (L.) Cyril. Susie Island, BBl 346; (also noted by B at Grand Portage).—Wet soil near habitations; introduced.

S. LONGIFOLIA Muhl. *sens. lat.* MacFarland Lake, BBl 337; South Fowl Lake, BM 10850, BABs 619; Grand Portage, Be 573, Be 647, BAA 454; Hovland, BR 4577.—Moist ditches, swales and trails.

The Minnesota material falls into two series, a narrow-leaved group of plants with capsules more or less darkened, and a broader-leaved group with straw-colored capsules. The latter is typical *S. longifolia* and the former is perhaps a separate variety.

Some of our material (BBl 337, BR 4577, BAA 454, and BABs 619) has the petals shorter than the sepals, thus departing from the description

given by Fernald in Gray's Manual, ed. 8, p. 623, but otherwise agrees in having the broader leaves and straw-colored capsules of the typical phase. BM 10850 however has the petals longer than the sepals and thus more nearly agrees with Fernald's description in Gray's Manual, ed. 8.

Be 573 and Be 647 have the dark capsules and narrower leaves of the other entity mentioned. This also occurs elsewhere in Minnesota.

S. calycantha (Ledeb.) Bong. (typical) *cf.* Fernald, Rhodora **42:** 255. West Bearskin Lake, BR 6364; Watab Lake, BAA 327; Susie Island, R 6043.—Moist portage trails and swales; rare.

S. calycantha, var. floribunda (Fernald) Fernald, Rhodora **42:** 255. Grand Portage, R 5990; Susie Island, OO 1037.—Rare in Minnesota.

Cerastium beeringianum Cham. & Schlect. *cf.* Fernald & Wiegand, Rhodora **22:** 169. Thunder Bay Dist., Ont. (North Fowl Lake), BABs 685.

While this has not yet been found in Cook County, the above locality on a slate cliff is immediately across the International Boundary from Minnesota, and it is to be expected that it will yet turn up on the Minnesota side of the boundary.

Fernald (Gray's Man., ed. 8, p. 626) gives the range of *C. beeringianum* as "Calcareous ledges and gravels, Lab. to w. Nfld. and Gaspé Pen. (ascending to 1000 m. alt.) and Rimouski Co., Que.; Alaska and Yuk. to Ariz." This is another of the notable range extensions that are associated with the sedimentaries of the Border Lakes.

C. vulgatum L., var. hirsutum Fries. Loon Lake, D 169; Carribeau River, BR 4516a.

C. vulgatum, var. hirsutum, f. glandulosum (Boenn.) Druce. Lima Mountain, BA 882.—Trail.

C. nutans Raf. North Lake, D. Lange 10.—Growing on an Indian camp ground.

Lychnis alba Mill. Susie Island, OO 1143.—Weed.

Silene antirrhina L. Mount Rose, SS 6063.—Dry, exposed rocky slopes. Essentially non-glutinous (f. *Deaneana* Fern.); and petals "whitish" according to the collectors' label data suggesting f. *bicolor* Farw., although in the dried state they are purplish below.

S. Armeria L. Grand Marais, H. W. Slack (July 1892).—Probably an escape.

PORTULACACEAE

Claytonia caroliniana Michx. Hovland, BR 4628.—Moist woods.

NYMPHAEACEAE

Nuphar microphyllum (Pers.) Fernald, Rhodora **19:** 111. Also *cf.* Rhodora **21:** 186 & Rhodora **39:** 407. Sawbill Lake, Bg 96; Daniels Lake, L. S. Cheney (July 14, 1891); Temperance River, C. B. Reif A20.—Depth of 2½ feet, muck and rock bottom, locally abundant.

Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) from Kadunce Creek.

N. × RUBRODISCUM Morong. Round Lake, C. B. Reif A3; Birch Lake, BA 807; Brule River, BR 4525.—Locally abundant, water up to 4 ft. deep, sand bottom. Reported by Smith and Moyle (*loc. cit.*) from Kadunce Creek.

N. VARIEGATUM Engelm. Leo Lake, BAA 330a; Clearwater Lake, BBl 396; Grand Portage, BR 6289; Brule River, BR 4524, C. B. Reif A34.—Shallow water to a depth of 4 ft., bottom mud to sand. Reported by Smith and Moyle (*loc. cit.*) from Two Island River, Poplar River, Cascade River.

NYMPHAEA ODORATA Ait. Horseshoe Lake, L. W. Orr 29; John Lake, BsH 267.—Very common. Reported by Smith and Moyle (*loc. cit.*) as from Kadunce Creek, although they state (*op. cit.*, p. 138) that it has been collected "only from ponded waters of the Baptism River."

N. TETRAGONA Georgi. This rarest of Minnesota species may be expected in Cook Co. because of its occurrence in near-by Lake County and on Isle Royale. Professor N. L. Huff's (no. 205, Jul. 31, 1914, Bald Eagle Lake, Lake Co.) notable collection has long stood as the only one for Minnesota in the Herbarium of the University of Minnesota. Very recently (Aug. 20, 1949) W. J. Breckenridge & J. A. Jarosz have added another station for the state at Mulligan Lake in Lake of the Woods County.

BRASENIA SCHREBERI Gmel. Sight record only. Reported by John De Q. Briggs and Marjorie W. Briggs to be locally very abundant in western Cook County.

RANUNCULACEAE

RANUNCULUS TRICHOPHYLLUS Chaix, var. TRICHOPHYLLUS., *cf.* RHODORA **38:** 18. Burnt Lake, J. De Q. & W. Briggs 125; Brule River, C. B. Reif (Aug. 1938); Mark Creek, C. B. Reif A24; Temperance River, C. B. Reif A2.—Mucky, sand or rock stream bottom; sometimes locally abundant. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) from Temperance River, Cascade River, Devil Track River, Kimball Creek and Brule River. They refer their specimens from the Arrowhead and Temperance River to var. *eradicatus* (Laest.) Drew (*loc. cit.*, p. 138).

R. LAPPONICUS L. Definitely reported from Cook County by L. S. Cheney (Trans.Wisc. Acad. Sci., Arts & Let. **9**: 235) on the basis of his collections of 1891. He states that he collected this species "on the Duluth and Port Arthur trail, three miles west of Mawshequawcawmaw River." His spelling of the name seems to be a variant of the Chippewa name (*cf.* W. Upham, Minnesota Geographic Names, Coll. Minn. Hist. Soc. 17: 140. 1920.) for the Reservation River. This puts Cheney's Cook County station for this species three miles west of the western boundary of the Grand Portage Indian Reservation. This location coincides very closely with Coulter & Fisher's (Bot. Gaz. **18:** 299) description of the locality as "twenty miles northeast of Grand Marais." There is no specimen representing this collection in the Herbarium of the University of Minnesota.

Less definite is the location of a collection made in 1870 by "Mr. Joseph C. Jones" who was "then of the U. S. Steamer *Search*" according to Asa Gray's account (Bot. Gaz. **11:** 17) of a letter received from the collector. Gray reported the collection under the name *Anemone nudicaulis* Gray, although he states that he "mistook the plant" for *Anemone Richardsonii*. Mr. Jones apparently gave Gray to understand that this plant was collected at "Sand bay, Minnesota, very near lat. 48°, and in or near the Canadian boundary." If the collection was made on the shore of Lake Superior this would put the station near Grand Portage. But "Sand bay" is an elusive locality, no place of this name being given for Cook County by Upham (*loc. cit.*), nor in the volumes of the Final Report on the Geology of Minnesota. It is perhaps significant that Coulter and Fisher (Bot. Gaz. **18:** 299) state that "Mr. Cheney's specimens were collected in the same region as the imperfectly known *Anemone nudicaulis* Gray, which Dr. N. L. Britton has shown to be Ranunculus Lapponicus."

This species is not yet represented in the Herbarium of the University of Minnesota from Cook County, but is known in the state from near-by St. Louis County (Lakela 8448), from Aitkin County (N. L. Huff, June 9, 1928) and from Itasca County (N. L. Huff, July 20, 1929 and Butters and Rosendahl 6851).

R. REPTANS L. *cf.* RHODORA **19:** 135. *R. Flammula* L., var. *reptans* Mey. Saganaga Lake, N 1681; Pigeon River, L. S. Cheney (Jul. 8, 1891); Smoke Lake, J. De Q. Briggs (sight record, Aug. 12, 1948).—Wet clay soil; general in the eastern and northern part of the state.

R. ABORTIVUS L., var. ACROLASIUS Fernald, RHODORA **40:** 418. Mountain Lake, BAA 324; South Fowl Lake, BABs 634; Mineral Center, BR 4599.—Moist woods and portage trails.

R. abortivus var. *acrolasius* tends to occur primarily in the northern part of the state and gives way to *R. abortivus*, var. *typicus* Fernald in the central and southern portion of the state.

R. PENSYLVANICUS L. f. Sawbill Lake, Bg 93; Partridge Lake, BA 785; Hungry Jack Lake, BAA 332; Mountain Lake, BAA 291; West Pike Lake, BsH 171; South Fowl Lake, BsH 292; Susie Island, R 6045, OO 1129; Grand Portage, Be 672; Grand Marais, T. S. Roberts (Jul. 27, 1879); Temperance River, C. B. Reif A 11.—Moist areas, sometimes submerged; abundant.

R. MACOUNII Britton. South Fowl Lake, BABs 633.—Marshy open area; rare. This is the second record from the state, the first being J. W. & M. F. Moore 11071 collected the previous year in an open meadow in Lake of the Woods County July 24, 1939.

R. ACRIS L. Mountain Lake, BAA 323; Brule River, E. Loula 21; Grand Portage, L. S. Cheney (Jul. 6, 1891), Be 582, S. Brown 2, BAA 459; Grand Marais, H. L. Lyon 918; Sawbill Trail, Bg 92, Bg 95.—Portage trails, roadsides, meadows; very common north of Lake Superior, rather uncommon elsewhere in the state.

THALICTRUM DASYCARPUM Fisch. & Lall. Seagull Lake, BA 916; Poplar Lake, D 83; Birch Lake, BA 776; Clearwater Lake, BsH 168;

Mountain Lake, BBsH 21; Royal River, BsH 288a, BsH 288b; Lucille Island, OO 1090; Grand Portage, Be 504, Be 506, Butters & Wherry (June 30, 1935); Mineral Center, BR 4570.—Portage trails, moist slopes, stream banks; common.

Anemone virginiana L. Grand Portage, BM 10868, BA 990; Mount Josephine, BA 1053.—Old trails.

A. canadensis L. Grand Portage, Be (Aug. 22, 1929), S. Brown 3; Mineral Center, BR 4571.—Paths, roadsides, stream banks.

A. quinquefolia L., var. interior Fernald, Rhodora **37:** 260. Tucker Lake, D 181; Mountain Lake, BAA 289, BAA 305; Pigeon River, BR 4612; Grand Marais, L. S. Cheney (June 26, 1891).—Portage trails, moist woods.

Clematis virginiana L., f. missouriensis (Rydb.) Fernald, Rhodora **39:** 309. Cross River, BBl 389, BA 894 (♀), BA 895 (♂); Susie Island, R 6042, OO 1034.—Thickets; very local, but abundant where it occurs. The Cook County material all seems to fall in this form with the characteristic silky pubescence, but the bulk of the material from the state is more or less strigulose pubescent; a very little is nearly or quite glabrate.

C. verticillaris DC. North Lake, D. Lange 13; Leo Lake, D 148; Watab Lake, BBl 432; Clearwater Lake, BA 100; North Fowl Lake, BABs 660; Mount Josephine, N 1610, BA 1047; Black Point, T. S. Roberts (Aug. 24, 1879).—Thickets; general but not common.

Caltha palustris L. Poplar Lake, D 23; Grand Portage, Be 540; Temperance River, C. B. Reif A7.—Wet, marshy areas, stream banks; common throughout the county. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) from the Temperance, Onion and Cascade Rivers.

C. natans Pall. This has long been known from Lake Vermillion and Tower and has recently been collected by Miss Lakela (no. 5110) in nearby St. Louis County. It is to be expected in Cook County.

Coptis groenlandica (Oeder) Fernald, Rhodora **31:** 142. Sea Gull Lake, L 3653; Poplar Lake, D 33; Watab Lake, BA 118a, BBsH 117; Pigeon River, BR 4553; Devil's Track River, T. S. Roberts (Aug. 15, 1879).—Sphagnum bogs and wet spruce woods; common.

Aquilegia canadensis L. Sawbill Lake, Bg 94; Watab Lake, BAA 231; Clearwater Lake, Butters & Wherry (June 28, 1935), BA 73, D 121; Brule River, E. Loula 1; Mountain Lake, BAA 248, BAA 298; Grand Portage, S. Brown 1; Carribeau River, BR 4497.—Cliffs, moist slopes and shady ledges. The flowers of the plants growing on the shaded cliffs are not infrequently of a yellowish cast and tend to be rather broad for their length which gives them a "stubby" appearance.

Actaea rubra (Ait.) Willd. Sea Gull Lake, L 3675; Mountain Lake, BAA 304, BBsH 31; South Fowl Lake, BABs 627; Poplar Lake, D 50a; Grand Portage, Be 516, Be 684, BR 6215, S. Brown (1935); Mineral Center, BR 4585; Kimball Creek, R 2617; Carribeau River, BR 4483, BR 4484.—Rich woods.

A. rubra. f. neglecta (Gillman) Robinson. *cf.* Fernald, Rhodora **42:** 261. Grand Portage, BR 6214, R 7902; Lutsen, L 4840; Thunder Bay Dist., Ont. (Pigeon Bay), AA 600.—Rich woods.

PAPAVERACEAE

Corydalis sempervirens (L.) Persoon. Sea Gull Lake, L 3629; Moss Lake, D 138, O 954; Winchell Lake, BA 140; Alder Lake, BsH 385; Lima Mountain, BA 873; Mountain Lake, BBsH 69; West Pike Lake, BBsH 178; East Pike Lake, BsH 213; MacFarland Lake, BBl 339, BsH 368; North Fowl Lake, BABs 656; South Fowl Lake, BM 10821; Morrison Bay, BBs 726; Belle Rose Island, OO 1058; Susie Island, BBl 349; Lucille Island, BAA 364; Sailboat Island, AA 533; Grand Portage, S. Brown 25; Mount Josephine, BA 168; Hovland, Be 611; Kimball Creek, R 2625; Grand Marais, F. F. Woods (June 23, 1891), BR 4660; Carlton Peak, T. S. Roberts (Aug. 25, 1879).—Cliffs, rocky shores, talus slopes, and generally in dry, sterile situations; common. There is a great deal of variation in the foliage of this species, but the floral structure is fairly constant.

C. aurea Willd., ssp. aurea. *cf.* G. B. Ownbey, Ann. Mo. Bot. Gard. 34: 229. Watab Lake, BAA 228; Clearwater Lake, BBl 419, BsH 160; Mountain Lake, BBsH 124, BBsH 131; West Pike Lake, BsH 199; East Pike Lake, BsH 218; South Fowl Lake, BABs 631, BM 10832; Royal River, BsH 344; Grand Portage, S. Brown 28, BA 147, BAA 458, SS 12030; Mount Josephine, BA 163; Temperance River, SS A5419.—Cliffs, talus slopes, hilltops, poplar woods; common.

The flowers of BsH 160 and BM 10832 have the outer petals with crests 0.5–0.75 mm. high, crenate or 3- to 4-toothed. Otherwise (size of flowers, shape and size of spur, fruit, seeds, leaves, bracts, etc.) they are like typical *C. aurea*. This is a variant which Dr. G. B. Ownbey assures us is apparently not uncommon (*cf.* Ownbey, *op. cit.*, p. 231).

CRUCIFERAE

Draba norvegica Gunner *cf.* Fernald, Rhodora **36:** 321. Susie Island, AA 562.—Unique occurrence in the gravel of a disintegrating dike. On the basis of the stations listed by Fernald (*loc. cit.*, and Gray's Man., ed. 8, p. 696) this is the first record for the species, not only in Minnesota, but also in the Great Lakes basin, the closest reported station being in the southeast corner of James Bay. It is another example of the series of species which appear to be isolated in the region.

D. arabisans Michx. (typical) *cf.* Fernald, Rhodora **36:** 353. Clearwater Lake, Butters and Wherry (June 29, 1935), BA 86; South Fowl Lake, BsH 280, BABs 614; Thunder Bay Dist., Ont. (North Fowl Lake) BABs 678, BABs 689.—Inland cliffs, often locally abundant. Otherwise known in the state only from Lake County, except for a Juni collection indicated simply as from the north shore of Lake Superior.

We include var. *canadensis* (Brunet) Fern. & Knowlt. in typical *D. arabisans* in spite of Fernald's continued recognition of this variety in Gray's Manual, ed. 8, p. 697. Fernald (*op. cit.*, p. 357) had earlier remarked that it is "presumably, not a very significant extreme." His feeling is fully justified by W. S. Cooper's no. 312 from Isle Royale (in Herb. Minn.) in which some of the siliques are short and relatively broad while other siliques on the same plant are twisted and flattened. It is

highly questionable in the face of this whether var. *canadensis* may be considered a stable taxonomic entity.

D. arabisans sens. lat. is represented from Cook County, and the Thunder Bay District of Ontario by eleven collections in the Herbarium of the University of Minnesota. Six of these agree perfectly with Professor Fernald's description (RHODORA **36:** 353) of the typical material. There is one minor exception to this statement, namely, that an occasional stellate hair may occur on the valves of a silique here and there. This condition, as indicated by an examination of other sheets in the Herbarium of the University of Minnesota, also exists in eastern material, such as, Collins and Fernald no. 92 (Bic, Rimouski County, Quebec), and Waghorne no. 22 (Bay of Islands, Newfoundland). The type specimen would seem to have a few stellate hairs on the valves, as indicated by Mrs. Ekman's discussion of it as quoted by Fernald (*op. cit.*, p. 251); Mrs. Ekman says of the type that "To the naked eye the fruits of *D. arabisans* looked glabrous, but under the microscope a few hairs were found in the margin of the valves of some of them."

Our remaining five collections, come from the slate cliffs and talus of Grand Portage, Minn. and nearby Pigeon Bay (Ont.). In these the siliques are markedly stellate pubescent, even when post-mature. This characteristic is not, however, always easily noted in specimens which have lain for any length of time in the herbarium—the protected siliques which have not been rubbed must sometimes be looked for. A striking fact is that collections made four different years in the vicinity of Grand Portage show that this characteristic has re-appeared consistently year after year. This very distinct variety bears the same relation to the typical material that *D. nemorosa* L., var. *lejocarpa* Lindbl. bears to *D. nemorosa* (typical), and *D. cuneifolia* Nutt., var. *leiocarpa* O. E. Schulz bears to *D. cuneifolia* Nutt.; it represents a trend which Fernald (*op. cit.*, p. 369) states is not uncommon when he compares *D. reptans* (Lam.) Fernald with *D. reptans*, var. *micrantha* (Nutt.) Fernald. This new variety of *D. arabisans* we propose as:—

D. ARABISANS Michx., var. **superiorensis** var. nov. A typo differt: siliculis stellato-pubescentis. TYPE: F. K. Butters, E. C. Abbe & L. B. Abbe 461, July 14, 1937, on the fern cliffs near Grand Portage (in Herb. Minn.). Other specimens seen: Minnesota—Rosendahl 6065, Aug. 14, 1929, ledges of rock, w. side of Grand Portage village; Butters and Buell 367, July 8, 1932, talus slope below calcareous cliff, Grand Portage; Butters and Abbe 158, June 28, 1936, talus below slate cliffs, Grand Portage; Thunder Bay District, Ontario—Abbe and Abbe 598, Aug. 21, 1937, dry slate cliffs on the north side of Pigeon Bay.

D. NEMOROSA L., var. LEJOCARPA Lindbl. *cf.* Fernald, RHODORA **36**: 366. Watab Lake, BA 113; Clearwater Lake, BA 124; Mountain Lake, BAA 250, BBsH 45; Pike Lake, BBsH 141; South Fowl Lake, BsH 318, BM 10833; Grand Portage, BA 157, BAA 461a; Mount Rose, SS 6067a.—Cliffs and talus slopes.

THLASPI ARVENSE L. Grand Marais, M. E. Oldenburg (Nov. 1944); Cascade River, BA 760.—Introduced weed.

Lepidium densiflorum Schrad. Brule River, BR 4528, BR 4529; Poplar Lake, BA 844.—Introduced weed.

Subularia aquatica L. Poplar Lake, BA 962.—Shallow water; very rare. First and only record of this species for the state in the Herbarium of the University of Minnesota.

Capsella Bursa-pastoris (L.) Medic. Grand Portage, Be 671.—Roadside.

Sinapis arvensis L. *Brassica arvensis* (L.) Rabenh. *Brassica Kaber* (DC.) L. C. Wheeler, var. *pinnatifida* (Stokes) L. C. Wheeler, Rhodora **40:** 306. Sawbill Lake, Bg 91; Grand Portage, Be 685.—Lake shore, road; weed. The pod characters given by Schulz (Pflzr., **105:** 119) seem to justify maintaining this as a genus apart from *Brassica*.

Erucastrum gallicum (Willd.) O. E. Schulz. Grand Marais, M. E. Oldenburg (Nov. 1944).

Descurainia pinnata (Walt.) Britt., var. brachycarpa (Richards.) Fernald, Rhodora **42:** 266. *D. brachycarpa* (Richardson) O. E. Schulz, Pflzrch. 105: 325. Grand Marais, L. S. Cheney (June 19, 1891).

Rorippa islandica (Oeder ex Murray) Borbás, var. Fernaldiana Butters and Abbe, Rhodora **42:** 28. *R. islandica*, var. *microcarpa* (Regel) Fernald, Rhodora **42:** 271; *cf.* Fernald, Rhodora **50:** 100. Sawbill Lake, Bg 90; John Lake, BM 10860; Lima Mountain, BA 853; Cascade River, BR 6914.—Rocky and sandy shores, roadsides; occasional.

R. islandica, var. hispida (Desv.). Butters and Abbe, Rhodora **42:** 26. Sea Gull Lake, N 1674.—Sandy lake shores.

Barbarea vulgaris R. Br. Lucille Island, OO 1095; Grand Portage, BA 1023.—Roadside.

Cardamine parviflora L., var. arenicola (Britton) O. E. Schulz. *cf.* Fernald, Rhodora **29:** 191. Sea Gull Lake, L 3689; Watab Lake, BA 105a, BAA 242; Clearwater Lake, BBl 408, Butters and Wherry (June 29, 1935), BA 74, BA 121, D 125c; Mountain Lake, BAA 260 & 297; West Pike Lake, BsH 177; East Pike Lake, BsH 216; North Fowl Lake, BABs 703; South Fowl Lake, BsH 283, BABs 623; Royal River, BsH 363; Mount Josephine, BA 166.—Ant-hills, cliffs, dry ridges and hilltops; often locally abundant. BA 74 is merely a depauperate form (f. *gracillima* O. E. Schulz, Engl. Bot. Jahrb., 32: 485) but all 40 or so individuals of the collection are uniformly similar.

C. pensylvanica Muhl. Gunflint Lake, BBl 375; South Lake, BA 783; Moss Lake, D 128; Hungry Jack Lake, BAA 328; Mount Josephine, BA 179; Mineral Center, BR 4598.—Moist places in trails, etc.; occasional. BA 179 grades from the usual state into var. *gracilis* O. E. Schulz, Engl. Bot. Jahrb. 32: 481.

(To be continued)

The Genus Lyonia in Missouri.—The occurrence of *Lyonia mariana* (L.) D. Don in Missouri was first observed this summer (1952) when several specimens were received for identification. As far as is known, this constitutes a new genus record for the State.[1] [2] Trips have since been taken to the location from which the specimens were collected, in order to establish more definitely the extent of *Lyonia* in this area.

Scattered colonies of *L. mariana* were found in two separate areas about a mile apart on Rubideaux Sandstone in Dent County, T35N, R7W; sections 15 and 16. These colonies varying from several stems to many hundreds occupied the low, sandy ground of two small drainages in rolling, wooded topography. One colony was observed on a more elevated site. In the larger of the two areas, colonies were scattered at intervals along the drainage for nearly a mile.

One landowner on whose property *Lyonia* is present stated that it has occurred here as long as he can remember, and periodically caused livestock poisoning. Previous owners, members of the same family, also had noted its presence in years past.

The presence of *Lyonia mariana* heretofor not known to occur in Missouri extends its range as given in the 8th edition of the Gray's Manual.[3] The Manual indicates that west Tennessee and Arkansas are the nearest limits to its presently known location in Missouri. This isolation in approximate south-central Missouri from these states to the south and east may indicate other locations when additional surveys are made.

In addition to deposits in the herbarium of the University of Missouri, specimens of *Lyonia* have been sent to the Missouri Botanical Garden, St. Louis, and the Chicago Natural History Museum.

Appreciation is expressed for the loan of herbarium material made by Dr. A. J. Sharp, University of Tennessee.—C. L. Kucera, Botany Department, University of Missouri, Columbia, Missouri.

[1] Palmer, E. J. and J. A. Steyermark. An Annotated Catalogue of the Flowering Plants of Missouri. Ann. Mo. Bot. Gard. 22: 375–758. 1935.

[2] J. A. Steyermark, personal communication, Curator of Herbarium, Chicago Nat. Hist. Museum.

[3] Fernald, M. L. Gray's Manual of Botany, 8th ed. 1950.

Elymus riparius in Illinois.—*Elymus riparius* Wiegand is a very distinctive species, which, like *E. canadensis* L., has usually nodding heads, but differs from that species in the straight awns of the lemmas and in the smaller paleas. In the second edition of Hitchcock's Manual of the Grasses of the United States (1950), its distribution is represented by dots as occurring in all the states surrounding Illinois. But for Illinois there is nothing but a blank indicated on the distribution map (p. 261). Nor is the species mentioned in either the first or second editions of Jones's Flora of Illinois.

It was, therefore, somewhat of a surprise to discover this species growing wild in the natural wooded ravines of the hilly Valparaiso Moraine section of northeastern Illinois where the author resides. These ravines have a rich mesophytic flora, and support such species as *Trillium flexipes, T. erectum, Smilax ecirrhata, Hepatica acutiloba* and *H. americana, Actaea pachypoda, A. rubra, Thalictrum dioicum, Sanguinaria canadensis, Dentaria laciniata, Dicentra Cucullaria, Caulophyllum thalictroides, Staphylea trifolia, Panax quinquefolius, Hydrophyllum virginianum, Lithospermum latifolium, Aster Shortii*, and a long list of other interesting species. Some of the indigenous species in the area, such as *Botrychium dissectum* (typical), *Liparis lilifolia, Convolvulus spithamaeus*, and others, constituted new county records for Illinois when originally discovered.

The finding of the first Illinois record of *Elymus riparius* is not too surprising, therefore, in view of the many rare or uncommon species already collected by the author in the same general vicinity. The specimen has been deposited in the Chicago Natural History Museum Herbarium. The data for it is, wooded ravine slopes near creek just east of Kimberley road, Biltmore Estates subdivision, 6 mi. northeast of Barrington, Lake Co., Illinois, August 14, 1948, *Steyermark 65952*, "heads nodding; leaves up to 2.2 cm. wide."—Julian A. Steyermark, Chicago Natural History Museum and Missouri Botanical Garden.

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Rhodora

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A HYBRID AMORPHA AND NEW FORMS AND RECORDS FROM MISSOURI

Ernest J. Palmer

The botanical activities of the author have been restricted during the past four years to collecting in a limited area in southwestern Missouri. It has been possible to make a rather intensive study of the flora of Barton, Lawrence, Dade and Newton counties, and to do a little additional exploring in Jasper, Stone, Barry, and a few other adjacent counties. This work has resulted in greatly expanding the plant lists of the four first mentioned counties and in turning up a number of unexpected plants, some of them not previously known in this part of the state and a few of them new to the state flora or not credited to the state in the eighth edition of Gray's Manual, or not recorded at all in that work. This list records and describes a hybrid Amorpha and new forms of two other plants, as well as new records for the state of several other species, varieties and forms. Several other plants are still under investigation and may be reported on later.

White-flowered forms of plants normally having colored corollas are not uncommon, and it seems that they are likely to occur in almost any genus. It has been customary and seems convenient to give them distinctive names. So far as I know, this is the first record of a hybrid in the genus *Amorpha*, although hybrids in a number of related leguminous genera are known in cultivation.

Amorpha canescens is a common plant of upland or rocky prairies in this vicinity. It is a low spreading plant seldom over half a meter in height, and it is conspicuous on account of the dense cinereous pubescence of the foliage and young branches, and

its densely flowered spikes of bright bluish purple flowers. *Amorpha fruticosa* is equally abundant, but grows in moister situations along small streams. It is a taller plant, up to two meters high, with green, thinly pubescent or nearly glabrous leaves and darker purple flowers. The plant taken as the type of the hybrid described below was found on a rocky bank between the upland prairie and an alluvial creek valley. Both supposed parent species are abundant within a short distance. The plant resembles *Amorpha canescens* in the dense gray pubescence of its foliage and young branches, and also in its pubescent inflorescence and fruit. But in the size, shape, and arrangement of the leaflets and in the form of the fruit with its curved back and short erect beak as well as in the character of the sepals it is closer to *Amorpha fruticosa.* While only one plant has been found, it too is intermediate in size and habit between the average of the two parent species.

Amorpha × notha, hyb. nov. (*Amorpha canescens* Pursh × *Amorpha fruticosa* L.).

Frutex erectus 1–1.5 m. altus, ramis annotinis gracilibus striato-sulcatis dense pubescentibus cineris, vestitudioribus teretibus glabris cinereo-brunneis. Folia conferta 5–10 cm. longa, 2–4.5 cm. lata superne aliquantum pubescentia infra dense cinerea; foliola 19–27, lateralia oblonga basi et apice rotunda, foliola terminalia obovata basi cuneata apice truncata vel emarginata. Inflorescentiae paniculato-racemosae densiflorae; flores 4–5 mm. longi sepalis brevi-deltoidis subaequalibus infimis anguste lanceolatis exceptis. Legumen obliquo-obovatum 4–5 mm. longum dorso incurvo pubescens punctato-glandulosum rostro erecto.

An erect shrub 1–1.5 m. tall with slender erect branches, deeply striate or sulcate and densely gray pubescent during the first season, becoming terete, glabrous and grayish brown the second year. Leaves 5–10 cm. long, 2–4.5 cm. wide, densely gray pubescent beneath, green and thinly pubescent above, firm at maturity. Leaflets 19–27, the lateral ones oblong, rounded at base and apex, 1–1.6 cm. long, 4–6 mm. wide, the terminal ones obovate cuneate at base and truncate or emarginate at apex, with deeply impressed midrib and obscure lateral veins. Flowers in densely flowered branching panicles, the terminal branch 8–10 cm. long and about 1 cm. thick, the lower ones shorter, more slender, and later-flowered. The four upper sepals very short deltoid and subequal, the lowest one longer and narrowly lanceolate. The entire panicle, like the foliage, densely gray pubescent, as are also the sepals; petals bright bluish-purple. Pods 4–5 mm. long, obliquely obovate, curved on the back, with a short erect beak, pubescent between the large black glandular dots.

Low rocky bank between upland prairie and the alluvial valley of Center Creek, about 1 mile north of Webb City, Jasper Co., Missouri.

E. J. Palmer, No. 52047, May 27, 1951 (type); *52930*, same collector and locality, Aug. 9, 1951 (paratype, in fruit).

Gerardia fasciculata Ell. forma **albiflora,** f. nov. A typo differt corollis albis. Swales of upland prairie, one half mile north of Webb City, Jasper Co., Missouri. *E. J. Palmer, No. 50841*, Aug. 30, 1950 (type).

Gerardia fasciculata is a southern species widely distributed in the coastal plain of the southern states. In Missouri it is confined to a few southwestern counties near the Kansas border, where it is common on moist prairies in some localities. A large colony of several hundred plants was found on a prairie just north of Webb City, in which perhaps two thirds of the flowers were pure white, while those of the remainder were of the usual pinkish purple color. I have not seen the white flowered form elsewhere.

Collinsia violacea Nutt. forma **pallida,** f. nov. A typo differt corollis albis mutatis valde pallidis purpureis exsiccatis. Rocky open upland woods and clearings, 3 miles s. w. of Webb City, Jasper Co., Missouri. *E. J. Palmer, No. 45867* (type), April 28, 1949.

The southwestern species related to Blue-eyed-Mary of farther north is one of the prettiest and most abundant wild flowers in rocky upland woods in parts of southwestern Missouri and through much of the Ozark region. A number of plants with pure white corollas were found growing among the normal violet-colored form. While the corollas of the living flowers were pure white, they changed to a very pale violet color when pressed and dried.

The types of the hybrid and two forms described above are in the herbarium of E. J. Palmer, Webb City, Missouri. Isotypes are in the herbarium of the Chicago Natural History Museum, and specimens will be sent to Gray Herbarium, the Missouri Botanical Garden, and other herbaria.

The following species, varieties and forms have not previously been recorded from Missouri or are not definitely shown within the state in the ranges given in the eighth edition of Gray's Manual:

Cinna arundinacea L. var. inexpansa Fern. and Grisc. *No. 49826*, Joplin, Jasper Co., Sept. 26, 1950; *51018*, Milford, Barton Co., Sept. 6, 1950; *51103*, Greenfield, Dade Co., Sept. 14, 1950.

Allium oleraceum L. *No. 50337*, cleared ground and border of woods, 1 mile east of Mt. Vernon, Lawrence Co. Abundant locally.

Arenaria serpyllifolia L. var. tenuior Mert. and Koch. Waste ground, *No. 49133*, rocky waste ground, Joplin, Jasper Co., June 8, 1949.

Ranunculus micranthus Nutt. var. delitescens (Greene) Fern. *No. 51721*, along wooded rocky bluff of Sac River, near Siebert, Dade Co., May 6, 1951.

Clematis dioscoreifolia Lévl. and Vaniot. *No. 50751*, waste ground, Aurora, Lawrence Co., Aug. 15, 1950; *54920*, along roadside, Webb City, Jasper Co., Aug. 24, 1952. This species is also growing as an escape near Eureka Springs, Arkansas.

Rorippa Islandica (Oeder) Borbas. *No. 51237*, Lawrenceburg, Lawrence Co., Sept. 27, 1950.

Vicia Cracca L. *No. 49124*, waste ground along Stockyard Switch, Joplin, Jasper Co., June 3, 1949.

Euphorbia heterophylla L. var. graminifolia (Michx.) Engelm. *No. 51108*, Avilla, Jasper Co., Sept. 20, 1950.

Viola sororia Willd. f. Beckwithae House. *No. 51520*, on moist shaded ledge of sandstone bluff, near Greenfield, Dade Co., Nov. 1, 1950; *51774*, same locality, May 6, 1951.

Ipomoea hederacea (L.) Jacq. var. integriuscula Gray. *No. 55129*, waste ground, upland prairie, near Carterville, Jasper C., Sept. 21, 1952.

Mimulus alatus Ait. f. albiflorus House. *No. 50783*, swampy ground along Spring River, near Verona, Lawrence Co., Aug. 22, 1950.

Valerianella olitoria (L.) Poll. *No. 51807*, waste ground along border of field and small stream, near Verona, Lawrence Co., May 10, 1951. The specimen was determined by Mrs. Sarah Dyall Nielsen.

Cirsium discolor (Muhl.) Spreng. f. albiflorum (Britt.) House. *No. 52951*, near Webb City, Jasper Co., Aug. 9, 1951.

The two following plants which were not included in the latest edition of Gray's Manual should be credited to Missouri, as reported by Palmer and Steyermark:[1]

Acacia angustissima (Mill.) Ktze. The typical glabrous form has been found in Barry County. A recent collection was *No. 52795*, rocky open woods, Roaring River State Park, July 25, 1951.

Baptisia sphaerocarpa Nutt. This southwestern species is well established along the Frisco railway between Washburn and Seligman, Barry Co., Mo., where it has been observed for many years, and several collections have been made. It has also been reported from St. Louis Co.

All of the collections reported above are under the author's numbers, and specimens of the plants are deposited in his herbarium.—Webb City, Missouri.

[1] An annotated catalogue of the flowering plants of Missouri, Ann. Mo. Bot. Gard. **22**: 573, 575. 1935.

A FLORISTIC STUDY OF COOK COUNTY, NORTHEASTERN MINNESOTA

FRED K. BUTTERS AND ERNST C. ABBE

(*Concluded*)

ARABIS LYRATA L. Porcupine Island, AA 582, BBs 749, OO 1056; Lucille Island, BAA 373.—Cracks in rocks on lake shore; rare. These collections are composed of plants in an extremely depauperate state. The fruiting plants vary from 2–6 cm. in height. The rosette leaves are so reduced in size that their characteristic lyrate lobing is almost or wholly suppressed, only an occasional leaf showing a shallow sinus on one or the other side. Furthermore the pods are shorter than average for the species, approximating in their dimensions those of *A. arenicola* (Richardson) Gelert, var. *pubescens* (S. Wats.) Gelert, although 0.5 mm. narrower than authentic material of the latter species. The combination of circumstances was such that we were for a time convinced that our material was indeed the latter species. However the somewhat more slender pods and the presence of an occasional shallow sinus in the basal leaves led us to plant viable seed from one of the collections. The seeds all produced plants with large, healthy rosettes 6 or more inches in diameter and leaves with a full development of the highly characteristic lyrate pattern of *A. lyrata*. We mention our experience with this material since we nearly fell into an error which others may wish to avoid. Plants similar in habit occur elsewhere in the Lake Superior region, as for instance, J. W. Robbins, Isle Royale, 1861; A. H. Smith, Islands of St. Ignace, July–Aug. 1871 (both in the Herbarium of the New York Botanical Garden) and Stuntz and Allen, no. 2 from Isle Royale (in the Gray Herbarium).

A. GLABRA (L.) Bernh. Poplar River, B. Juni (1878).

Reported by Juni (*op. cit.*) as *A. perfoliata* Lam.

A. HIRSUTA (L.) Scop., var. PYCNOCARPA (Hopkins) Rollins, RHODORA **43:** 318. *A. pycnocarpa* Hopkins, var. *typica* Hopkins, RHODORA **39:** 113. Hungry Jack Lake, BsH 422; Clearwater Lake, BBl 411; Little Caribou Lake, BsH 399; Mountain Lake, BBsH 46, BBsH 128; West Pike Lake, BsH 191, BsH 201; Royal Lake, BsH 252, BsH 365; Clark's Bay, BAA 395a; Morrison's Bay, BBs 739; Grand Portage, BAA 462a; Mount Josephine, BA 182a; Thunder Bay Dist., Ont. (Pigeon Bay) AA 599.—Cliffs, talus slopes, hill-tops and shore rocks; local.

The following specimens of *A. hirsuta* represent a phase with very numerous (but not appressed) forked hairs on the basal portion of the stem, making it difficult to assign them to any, of Hopkins' (*loc. cit.*) or Rollins' (*loc. cit.*) varieties:—Clearwater Lake, N 1699, BA 80; Mountain Lake, BBsH 130; East Pike Lake, BsH 227; MacFarland Lake, BM 10806; Grand Portage, BA 156, BAA 462.

A. DIVARICARPA A. Nelson, var. TYPICA Hopkins, RHODORA **39:** 129. *cf.* Rollins, RHODORA **43:** 375. Cross River, BA 924; Watab Lake, BA 114a;

Clearwater Lake, BBl 410, N 1690, Butters and Wherry (June 29, 1935), BA 76, BA 955, D 125a; West Pike Lake, BsH 205; East Pike Lake, BsH 226; North Fowl Lake, BABs 705; South Fowl Lake, BsH 279, BM 10828; Royal Lake, BsH 253, BsH 339; Pigeon Point, BAA 409; Clark's Bay, NBr 3235a; Grand Portage, BBl 368, BA 182, BM 10886; Mount Josephine, BA 182; Thunder Bay Dist., Ont. (Pigeon Bay), AA 599a.—Cliffs, talus slopes, hilltops.

A. Holboellii Hornem., var. retrofracta (Graham) Rydb. *cf.* Rollins, Rhodora **43:** 441. Mountain Lake, BBsH 139.—Cliff; very rare. First report from the state. According to Rollins (*loc. cit.*) it occurs "Locally in Quebec and Michigan, more abundant westward from Saskatchewan and Alberta . . ." Our material thus helps fill in a part of the gap between the more western stations and the Quebec and Michigan ones.

A. divaricarpa var. typica × A. holboellii var. retrofracta. South Fowl Lake, BsH 316. Cliffs; unique. This collection combines in varying degrees the characters of the probable parents, except for its pods which are abnormal in shape; the pods have developed to the point of dehiscence, but seeds have failed to form. Dr. M. Hopkins (*in litt.*, Jan. 30, 1939) agrees to this assignment of the collection, *sub. nom.*, *A. divaricarpa* A. Nelson × *A. pendulocarpa* A. Nelson.

SARRACENIACEAE

Sarracenia purpurea L. Sea Gull Lake, L 3698; Sawbill Lake, Bg 86; Poplar Lake, L. W. Orr 26; Mountain Lake, BAA 295; Clearwater Lake, BA (sight record).—Black spruce muskeg, sphagnum bogs, etc.; quite rare in eastern Cook Co. because of the scarcity of appropriate bogs.

DROSERACEAE

Drosera intermedia Hayne. *D. longifolia* of Gray's Man. ed. 7. Sawbill Lake, Bg 85; Northern Light Lake, MacMillan Brand and Lyon 72; Grand Portage, S A5307.—Pool and lake margins.

D. rotundifolia L. Kelso River, Bg 84; Gunflint Lake, SS 6014; Hungry Jack Lake, BR 6355; Poplar Lake, BA 830; Clark's Bay, B (Sep. 3, 1927); Porcupine Island, OO 1017; Belle Rose Island, OO 1068; Susie Island, N 1649, OO 1132; Long Island, BAA 464, AA 504, OS 1114; Grand Portage, Be 675, BR 6304; Temperance River, SS 6029, S A7414, OS 1001.—Bogs, moist sphagnum in deep woods, pool margins.

SAXIFRAGACEAE

Saxifraga virginiensis Michx. Clearwater Lake, BBl 406, BBl 409, N 1707, Butters & Wherry (June 29, 1935), BA 61, BA 129, BA (June 21, 1936), BBsH 9, D 113, D 125b; Mountain Lake, BBsH 135; West Pike Lake, BsH 179, BsH 197; East Pike Lake, BsH 219; North Fowl Lake, BABs 676; South Fowl Lake, BsH 277, BM 10827, BABs 613; Royal Lake, BsH 254, BsH 219, BsH 254; Pigeon River, BR 4605; Mount Josephine, BR 6321.—Cliffs; very local.

Elsewhere in the state this species occurs at Duluth and Two Harbors on the shore of Lake Superior, in the extreme northern part of Lake and

St. Louis Counties and at the Lake of the Woods. This is an extremely northern pattern of distribution within the state, resembling that of *Ranunculus lapponicus*. This is very peculiar, because throughout its range it is characteristically a temperate region species of northeastern U. S. and southeastern Canada. On the basis of its distribution elsewhere it might well be expected to be more widespread in the state, rather than restricted to its cool northern fringe.

The Minnesota material has been studied carefully to see if it could not possibly be placed elsewhere, but it agrees perfectly with eastern material in its floral structures, seeds, etc. Superficially some of our specimens resemble *S. nivalis* L., but are distinguishable on the basis of the flower structure, *S. nivalis* having shorter petals, a coarser flower for the size of the plant, the lower part of the flower larger and perhaps deeper, and the bracts larger and ovate rather than narrowly lanceolate.

Our material shows much the same range of variation as occurs in the East, some specimens being loosely paniculate with monochasial branches and short-pedicelled flowers—others are glomerulate and the flowers scarcely at all pedicelled (S. VIRGINIENSIS, f. GLOMERULATA Fernald, RHODORA **19:** 143)—whether the latter is to be recognized as a special form is an open question, since much of the difference may be due to age.

S. CERNUA L., f. LATIBRACTEATA (Fern. & Weath.) Polunin, Jour. Bot. **76:** 100. Mountain Lake, BAA 279, BBsH 80.—Upper margin of fine talus at base of diabase cliff; only known location in Minnesota—an area of about 5 sq. ft. Our material is clearly Fernald and Weatherby's entity and extends their description (RHODORA **33:** 234) of the range "Baffin Island, Gaspé Peninsula, Quebec; Keewatin and Alberta" significantly southward in the mid-continental region. The closest station to ours cited by Fernald is Fullerton, Keewatin. Our material is composed of flourishing specimens, one freely branched, from 12 cm. up to 3 dm. high.

S. AIZOÖN Jacq., var. NEOGAEA Butters, RHODORA **46:** 65. Watab Lake, BA 109a; Clearwater Lake, BBl 407, N 1697, BA 90, Butters & Abbe (Jun. 21, 1936), BBsH 12; Mountain Lake, BAA 251, BBsH 52, BBsH 81; MacFarland Lake, BsH 369; South Fowl Lake, BsH 273, BABs 612; Royal Lake, BsH 360, BM 10848; Thunder Bay Dist., Ont. (North Fowl Lake) BABs 683, (South Fowl Lake) BABs 709.—Cliffs of the Border Lakes; very local. This has been discussed in detail in Butters (*loc. cit.*).

HEUCHERA RICHARDSONII R. Br. (typical). Lake Saganaga, L. S. Cheney (Jul. 24, 1891); Sea Gull Lake, N 1667.—Acid rocks; infrequent in the county.

H. RICHARDSONII, var. HISPIDIOR Rosend., But. & Lak. Sea Gull River, N 1671; Rove Lake, BBl 427; Watab Lake, BAA 222, BBsH 110, SS 6017; Clearwater Lake, BBl 401, N 1710, BA 106, D 111; Royal Lake, BsH 241; Thunder Bay Dist., Ont. (Mountain Lake), BAA 310, (North Fowl Lake) BABs 698.—Cliffs (slate, diabase, granite), sometimes wooded; the common representative of the species in the region, not being restricted to acid substratum.

Mitella nuda L. Sea Gull Lake, L 3640; Sawbill Lake, Bg 83; Loon Lake, D 185c; Poplar Lake, D 37; Rove Lake, BA 116; Clark's Bay, BBs 720; Lucille Island, BAA 371; Grand Portage, Be 539, R 6014, S. Brown 37, Butters & Wherry (June 29, 1935); Brule River, R (Sep. 11, 1927); Grand Marais, T. S. Roberts (July 30, 1879); Carribeau River, BR 4495.—Moist woods; very frequent.

Chrysosplenium americanum Schwein. Kimball Creek, R 2603; Devil's Track River, BR 4662.—Moist places; rare. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, 134) from the Brule River.

Parnassia palustris L., var. neogaea Fernald, Rhodora **39:** 311. Susie Island, OO 1031; Grand Portage, Be 646, BR 6303; Temperance River, SS 6027, OO 999; Schroeder, BA 1066, L 6427, OS 982.—Moist places; rare, but locally abundant. Reported by Juni (*loc. cit.*) from Grand Portage Island.

Ribes hirtellum Michx. Brule River, BR 4519; Cross River, BA 896.

Mr. D. M. Stewart reports to us that this occurs north to the border and is general as to habitat.

R. oxyacanthoides L. Gunflint Lake, R 5449; Clearwater Lake, BBl 405, BA 957, D 117; Susie Island, R 6039; Grand Portage, Be 579, R 6017, BR 6212; Brule River, BR 4540; Grand Marais, R 5972, BR 6913, BA 50; Carribeau River, BR 4462; Tofte, R 7833.—Moist woods and openings; frequent.

R. lacustre (Pers.) Poir. Clearwater Lake, BBl 421, BA 54; Mountain Lake, BBsH 83; Grand Portage, R 5994, BR 6205, Be 589; Pigeon Point, BA 995; Kimball Creek, R 2624; Grand Marais, BR 4656; Carribeau River, BR 4489.—Moist woods. Also reported from the North Brule by Mr. D. M. Stewart.

R. glandulosum Grauer. *R. prostratum* L'Hér. Winchell Lake, BA 136; Poplar Lake, D 5, D 18; John Lake, BM 10781; South Fowl Lake, BABs 621; Susie Island, OO 1121; Grand Portage, Be 480; Brule River, BR 4541; Kimball Creek, R 2633; Grand Marais, BA 48.—Moist woods; general.

R. triste Pallas. Loon Lake, D 176; Grand Portage, Be 544, Butters & Wherry (June 30, 1935); Kimball Creek, R 2623.

Mr. D. M. Stewart informs us that this species is general in the county.

R. hudsonianum Richards. Poplar Lake, L. W. Orr 27, D 3; Clearwater Lake, BBl 443; Pigeon River, BR 4558; Clark's Bay, B (Sep. 3, 1927), BAA 396; Susie Island, OO 1122; Grand Portage, R 6028b.—Swampy woods; frequent. Also reported from the North Brule by Mr. D. M. Stewart.

ROSACEAE

Physocarpus opulifolius (L.) Maxim. Clark's Bay, NM 3657, BAA (Jul. 12, 1937); Morrison Bay, BBl 358; Susie Island, P. A. Rydberg 9712, AA 563, OO 1025; Grand Portage, R 6032a; Grand Marais, H. W. Slack (Jul. 1892); Tofte, L 4838.—Beaches and islands along the shore of Lake Superior.

All of the material from Duluth to Pigeon Point is *P. opulifolius* rather than *P. opulifolius*, var. *intermedius* (Rydb.) Robins., although some

pubescence persists on the glossy and darker carpels, notably along the sutures, in some cases (AA 563) as late as Aug. 20, when the fruit is nearly ripe.

SPIRAEA ALBA DuRoi. Sea Gull River, BA 903; Cross River, BR 6371; John Lake, BsH 266; Grand Portage, Be 656; Grand Marais, R 5959, BR (Aug. 14, 1934).—Lake shores, stream banks, moist woods, borders of swamps; common.

PYRUS MELANOCARPA (Michx.) Willd. *Aronia melanocarpa* (Michx.) Spach. Grand Marais, H. W. Slack (Jul. 1892).—A very dubious record.

P. AMERICANA (Marsh.) DC. *Sorbus americana* Marsh. Sawbill Lake, D. G. Schaal (8-6-38); Gunflint Lake, R 5447, R 5456; Watab Lake, BAA 235; Grand Portage, Be 555, Be 586, BR 6204; Mineral Center, BR 4583; Brule River, R 5439; Kimball Creek, R 2625; Grand Marais, R 5969, BBl 477; Lutsen, R 5439.—Roadsides, woods, talus slopes; occasional.

P. DECORA (Sarg.) Hyland. *Sorbus decora* (Sarg.) Schneid. *S. subvestita sensu* Rosendahl & Butters, Trees and Shrubs of Minnesota, p. 195, 1928, not Greene, 1900. Gunflint Lake, R 5454; Winchell Lake, BA (June 27, 1936); Lucille Island, BAA 356; Grand Portage, R 6035a; Mt. Rose, R 7910.—Trails, woods; frequent.

While *P. americana* is sometimes shrubby in Cook Co., *P. decora* in the Lake Superior region is a fairly large tree and in places practically lines the shore, as for example at Clark's Bay. *P. decora* is much more common than the number of collections indicates, but because it is a good-sized tree it is not often collected.

AMELANCHIER[13] SANGUINEA (Pursh) DC. Sea Gull Lake, N 1670, N 1672; Clearwater Lake, BBl 412, N 1704, N 1705; Grand Portage, Be 530, Be 558, R 6072, R 6203; Mount Josephine, NE 2044; Clark's Bay, NM 3655, MN 3663; Porcupine Island, BR 6258; Kimball Creek, R 2635; Devil's Track River, C. W. Hall (Aug. 21, 1879).—Woods and talus slopes. Nielsen (Amer. Midl. Nat. **22:** 169) says "In Minnesota this species is limited to the extreme southeast and northeast corners of the state."

A. HURONENSIS Wieg. Watab Lake, BAA 229; Lima Mountain, BA 878; North Fowl Lake, BABs 658; Pigeon Point, N 1645; Clark's Bay, NE 2024, NE 2031, NE 2038, NE 2040a; Wauswaugoning Bay, NE 2022; Mount Josephine, N 1606, N 1615, N 1616, NE 2014, NE 2017, NE 2045, NE 2046, NE 2048, NE 2049; Grand Portage, BBl 370, N 1613, NBr 3225, NBr 3226, NBr 3228, R 7860, R 7863; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 701.—Nielsen (*op. cit.*, p. 171) says "In Minnesota it occurs on calcareous drift or on basic rock outcrops of the northern or northeastern parts of the state."

A. WIEGANDII Nielsen, Amer. Midl. Nat. **22:** 180. Pigeon Point, BAA 407; Clark's Bay, N 1623, NE 2028, NE 2030, NE 2033, NE 2040, NE 2041, NBr 3228a, NBr 3229, NBr 3232, NBr 3236, NBr 3237, NBr 3238, NBr 3241, NM 3659, NM 3662, NM 3666; Wauswaugoning Bay, NE 2018, NE 2020, NE 2021, NE 2027, NE 2032; Lucille Island, N 1663;

[13] The determinations of *Amelanchier* are primarily by E. L. Nielsen, especially specimens collected by N, Br, E, or R.

Mount Josephine, N 1614, NE 2016; Mount Rose, R 7909; Tofte, NE 1998, NBr 3160.—Described by Nielsen (*op. cit.*, p. 180) as occurring in Minnesota along the north shore of Lake Superior and east of the divide paralleling the lake.

A. HUMILIS Wieg., var. COMPACTA Nielsen, Amer. Midl. Nat. **22:** 174. Grand Portage, NBr 3221, NBr 3222; Grand Marais, BA 774.—Nielsen (*op. cit.*, p. 175) considers this to be the most common variant of the species in the state and states that it is "frequent in the forested portion of the state, but more typically developed in the coniferous belt."

A. MUCRONATA Nielsen, Amer. Midl. Nat. **22:** 178. Clark's Bay, NE 2036, NE 2042, NE 2043, NM 3230, NBr 3230a, NBr 3234, NBr 3239, NBr 3242, NM 3664.—Nielsen (*op. cit.*, p. 179) points out that his new species is known only from Clark's Bay, although Fernald (Gray's Man., ed. 8, p. 765) gives its range as "n. Minn. and se. Man."

A. STOLONIFERA Wieg. Clark's Bay, N 1617, NBr 3231, NBr 3232a, NBr 3233, NBr 3235, NBr 3240, NM 3661, NM 3665; Grand Portage, Be 531.—According to Nielsen (*op. cit.*, p. 178) it is "confined to acid rock outcrops and sandy areas in northeastern Minnesota."

A. CANADENSIS (L.) Medic. Mount Josephine, N 1605, N 1607, N 1611, N 1612.—According to Nielsen (*op. cit.*, p. 183) it is limited in Minnesota to the southeast and northeast corners of the state where its occurrence is very infrequent.

A. INTERMEDIA Spach. Clearwater Lake, BBl 450.—Reported by Nielsen (*op. cit.*, p. 186) from Minnesota only "along the Mississippi River from Anoka and Washington Counties south to the Iowa boundary."

A. LAEVIS Wiegand. Grand Portage, Be 483, BA 193.—Nielsen (*op. cit.*, p. 188) states that it occurs rather commonly throughout the forested portion of the state.

A. BARTRAMIANA (Tausch.) Roem. Pigeon River, BR 4561; Clark's Bay, N 1620, NE 2034, NE 2035; Sailboat Island, AA 538; Grand Portage, R 6073, NBr 3224; Tofte, N 1354; Schroeder, N 1731, NBr 3209.—According to Nielsen (*op. cit.*, p. 189) it is confined to the part of Minnesota north of Lake Superior.

A. BARTRAMIANA × A. LAEVIS. Winchell Lake, BA 141.—A number of other hybrids (determined by E. L. Nielsen) from our area are represented in the Herbarium of the University of Minnesota, but are not listed. Hybridization apparently occurs in this genus with great freedom.

CRATAEGUS COLUMBIANA Howell, var. PIPERI (Britton) Egglest. Cross River, BBl 392; North Lake, D. Lange 11; North Fowl Lake, BABs 702; Pigeon River, BR 6263; Grand Portage, Butters & Wherry (June 30, 1935).—Portage trails and thickets.

This member of the ROTUNDIFOLIAE, because of its close resemblance to western material, is referred by the writers to *C. columbiana* var. *Piperi* of ed. 7, Gray's Manual, rather than to any of the taxa placed in this group in ed. 8 of Gray's Manual. The Cook County material is markedly similar to Wm. C. Cusick 2512 ("Eastern Oregon Plants," 1901) in:—the shape and toothing of the leaves, its gray twigs and grayish-olive

branchlets, its relatively slender pedicels and peduncles, the stamens usually being fewer than 10, the filaments which are widened at the base, the three (rarely four) styles and nutlets, the similarity in size of nutlets which often have shallow pits on the inner faces: furthermore, the immature (August) fruits resemble closely the size, color and form of those of J. F. Macbride 1618 (Sweet, Boise County, Idaho, Aug. 12, 1911).

C. Douglasii Lindl. Grand Portage, R 6074, BR 6200, BR 6266, NE 2013, Butters & Wherry (June 1935), BA 1015.—Thicket; seen only in Grand Portage village. Our material agrees very well with typical western material. The prematurely ripe and drooping fruits in our collection BA 1015 are almost black, most of them being still immature are dark mahogany at this date (Aug. 12, 1944). The long stones of the fruit are up to 6.4 mm. in length which somewhat exceeds the upper limit indicated in Gray's Man., ed. 7 (5–6 mm.), but resemble very closely those from Piper's 1536 from Pullman, Wash. Fernald (Rhodora **37:** 272) mentions the occurrence of this species at various stations on the Great Lakes, to which the above locality should be added.

Fragaria virginiana Duchesne. Sawbill Lake, Bg 6; Poplar Lake, D 17; South Fowl Lake, BM 10844, BABs 645; Clark's Bay, NM 3667; Grand Portage, S. Brown 12; Brule River, BR 4531; Grand Marais, BR 4657; Bally Creek, C. B. Reif A31.—Roadsides, open woods, beaches; common.

F. vesca L., var. americana Porter. Sea Gull Lake, L 3617; Clearwater Lake, Butters & Wherry (June 29, 1935), BA 60; Mountain Lake, BAA 277, BAA 288, BBsH 42; John Lake, BM 10802; Susie Island, AA 559; Grand Portage, Be 469; Kimball Creek, R 2621.—Nearly ubiquitous in Cook Co. In several collections the fruits are subglobose rather than pyramidal.

Potentilla fruticosa L. (typical). Morrison Bay, BBl 357; Long Island, AA 505; Grand Marais, T. S. Roberts (Jul. 30, 1879), H. L. Lyon 923, BR 4647.—Ledges and rocks; abundant.

P. fruticosa, var. tenuifolia (Willd.) Lehm. Pigeon Point, R 6077, N 1635, BAA 417, BAA 416; Grand Marais, T. S. Roberts (Jul. 31, 1879), L. S. Cheney (June 27, 1891), H. W. Slack (Jul. 1892), BM 10788; Temperance River, SS 6028.—Ledges and rocks; abundant. Whenever *P. fruticosa* has been collected more than once from a given locality in Cook County the variety also shows up. It is doubtful whether the variety should be considered more than a form.

The distribution of the species (*sens. lat.*) in the state is peculiarly sporadic and local, except on the north shore of Lake Superior where it is common. It also occurs in the vicinity of St. Cloud and in the Minnesota valley near Savage and has been reported by Upham from the northern Red River valley. The Minnesota Valley material is var. *tenuifolia*. All the places where it occurs in the state are singularly inappropriate for glacial relics (in the narrow sense) because post-glacial bodies of water occupied these areas until relatively recent geological times. Its present distribution, other than by existing bodies of water, may well reflect a

former littoral occurrence so that it may be considered as a "post-glacial" relic.

P. tridentata Solander *in* Aiton. Sea Gull Lake, L 3710; Alton Lake, Bg 80; Gunflint Lake, BBl 381, SS 6013; North Lake, D. Lange 9; Watab Lake, BA 103; Little Caribou Lake, BsH 391; East Pike Lake, BsH 229; North Fowl Lake, BABs 655; Pigeon Point, R 6078; Clark's Bay, NM (Oct. 6, 1935); Porcupine Island, OO 1011; Belle Rose Island, BR 6238; Susie Island, BBl 352; Lucille Island, BAA 341; Long Island, AA 526; Mount Josephine, BA 167; Brule River, BR 4536; Grand Marais, T. S. Roberts (Jul. 31, 1879), L. S. Cheney (Jun. 27, 1891), H. L. Lyon 122, BM 10774; Temperance River, SS 6039.—Exposed rocks; common.

P. palustris (L.) Scop. Sea Gull Lake, BR 2523; Sawbill Lake, Bg 81; West Pike Lake, BsH 170; Otter Lake, BA 797; Agnes Lake, L. W. Krefting 24; Grand Marais, H. W. Slack (Jul. 1892); Bally Creek, C. B. Reif A33.—Swampy areas; infrequent because of limited number of appropriate habitats. Reported by Smith & Moyle (Minn. Dept. of Cons., Tech. Bull. 1, p. 134) from Two Island and Cascade Rivers and Kimball Creek.

P. arguta Pursh. Clearwater Lake, N 1701; West Pike Lake, BsH 190; Mount Josephine, BA 165; Thunder Bay Dist., Ont. (Pigeon Bay), AA 608.—Cliffs and crevices in rocks.

P. pensylvanica L. *cf.* Fernald, Rhodora **37**: 286. Grand Portage, Pease & Bean (July 4, 1937, in Gray Herbarium), R 7862; Thunder Bay Dist., Ont. (Pigeon Bay), AA 602.—Dry habitats; very local.

P. glabrella Rydb. Grand Portage, R 6066, BR 6201, BA 155a.—Talus below slate cliff; very local.

P. gracilis Dougl., var. pulcherrima (Lehm.) Fernald, Rhodora **42**: 213. Schroeder, L 6422.—Roadside ditch; rare. Otherwise known from Minnesota only by Miss Lakela's collections in the vicinity of Duluth.

P. norvegica L., var. hirsuta (Michx.) Lehm. *P. monspeliensis* L. Sawbill Lake, Bg 4, Bg 5; Rove Lake, BBl 435; Watab Lake, BA 114; Clearwater Lake, BA 77, BBsH 7, D 116; Mountain Lake, BAA 259, BAA 299; Pigeon Point, N 1633; Susie Island, OO 1028, OO 1139; Lucille Island, OO 1092; Grand Portage, Be 511, Be 551; Mount Josephine, BR 6316; Grand Marais, T. S. Roberts (Jul. 27, 1879).—Cliffs, rocky crevices, moist woods; occasional.

Geum aleppicum Jacq., var. strictum (Ait.) Fernald, Rhodora **37**: 294. Sawbill Lake, Bg 82, South Fowl Lake, BsH 295; Royal River, BsH 260; Susie Island, OO 1142; Grand Portage, Be 513, S. Brown (1935), R 7893; Grand Marais, T. S. Roberts (Jul. 31, 1879).—Portage trails, beaches.

G. macrophyllum Willd. Grand Portage, R 7894; Grand Marais, T. S. Roberts (Aug. 13, 1879).—Moist thicket.

G. rivale L. Pigeon River, L. S. Cheney (Jul. 9, 1891).

Rubus pubescens Raf. Gunflint Lake, R 5450; Loon Lake, D 165; Poplar Lake, L. W. Orr 21, D 31; Grand Portage, S. Brown 4; Kimball Creek, R 2630.—Moist meadows, openings in woods; very abundant.

R. PARVIFLORUS Nutt. (*sens. lat.*). Grand Portage, L. S. Cheney (Jul. 3, 1891), BBl 344; Grand Marais, T. S. Roberts (Jul. 30, 1879), R 2612; Grand Portage, S. Brown (1935); Hovland, BR 4627.—Openings in hardwoods; local.

R. IDAEUS L., var. STRIGOSUS (Michx.) Maxim. Pigeon Point, N 1641.

R. IDAEUS, var. CANADENSIS Richards. Winchell Lake, BA 137; Brule River, R 5956; Grand Portage, Be 510, Be 542; Grand Marais, R 2627, R 5956.—Moist openings in woods; common. This variety is the more abundant phase in Cook Co., while the preceding variety is more common to the south in the state.

AGRIMONIA STRIATA Michx. South Lake, BA 787; Leo Lake, BAA 340; West Pike Lake, BsH 207; Pigeon River, R 6030b; Grand Portage, Be 570, S. Brown (1935).—Portage trails, moist woods.

ROSA ACICULARIS Lindl. Gunflint Lake, R 5457; Poplar Lake, R 5433; Clearwater Lake, BA 58; Brule River, NM 3656; South Fowl Lake, BABs 649; Clark's Bay, B (Sep. 1, 1927); Grand Portage, Be 478, Be 541, Hovland, BR 4626; Kimball Creek, R 2631; Grand Marais, N. L. Huff (Jul. 12, 1925), R 5958; Tofte, R 7834.—Openings in and margins of woods; roadsides, stream beds. Of the above collections, BA 58 may be assigned to var. *lacorum*[14] Erlanson (Papers Mich. Acad. Sci., Arts and Letters **5:** 86. 1925), R 2631 to var. *rotunda* Erlanson, and R 5433 to var. *Sayiana* Erlanson.

R. ACICULARIS, var. BOURGEAUIANA Crépin. Sea Gull Lake, L 3608; Grand Portage, Rydberg and Rosendahl 5989; Tofte, R 7835; Grand Marais, R 2632.—Openings and margins, woods.

R. BLANDA Ait. Sea Gull Lake, L 3607; Grand Portage, BA 1055, BA 1056.—Lake shore, roadside.

PRUNUS SUSQUEHANAE Willd. Lake Saganaga, L. S. Cheney (Jul. 23, 1891); Sea Gull Lake, L 3706.—Shore rocks.

P. PENSYLVANICA L. f. Cross River, BA 926; Poplar Lake, D 27; Grand Portage, Be 482, Be 495, Be 525, Butters & Wherry (Jun. 30, 1935); Brule River, BR 4535; Kimball Creek, R 2637.—Lake shores, mixed woods. The nature of the climate in Cook Co. is indicated by the fact that this is in flower the first of July.

P. VIRGINIANA L. Loon Lake, D 172; Watab Lake, BAA 220; Clearwater Lake, D 122; Mineral Center, Be 679; Hovland, BR 4625; Grand Marais, L. S. Cheney (Jun. 22, 1891).—Mixed woods.

LEGUMINOSAE

TRIFOLIUM PRATENSE L. Sawbill Lake, Bg 78; Brule River, E. Loula 7; Grand Portage, Be 492.—Roadside, openings in woods.

T. REPENS L. Sawbill Lake, Bg 79; Susie Island, OO 1138; Brule River, E. Loula 3.—Roadsides; according to G. B. Ownbey "apparently introduced and becoming naturalized" on Susie Island.

T. HYBRIDUM L. Sawbill Lake, Bg 77; Grand Portage, Be 549.—Old trails, roadsides.

[14] It should be pointed out that "*lacorum*" is improper Latin, the correct genitive plural of "*lacus*" being "*lacuum.*"

T. agrarium L. Cascade, E. Loula 9.—Sandy soil.

T. procumbens L. Grand Marais, M. E. Oldenburg (Nov. 1944).—Gravelly area.

Melilotus officinalis (L.) Lam. Grand Portage, BA 1022.—Roadside.

M. alba Desr. Loon Lake, BA 931.—Roadside; very infrequent, but locally abundant.

Oxytropis ixodes Butters & Abbe, Rhodora **45:** 2. South Fowl Lake, BsH 327, BABs 611.—Isolated on a single slate cliff; locally abundant.

This phytogeographically significant endemic has been discussed in detail by the writers elsewhere (*loc. cit.*). It is one of the group of viscid-glandular species which includes *O. gaspensis* Fernald & Kelsey, *O. hudsonica* (Greene) Fernald, *O. viscida* Nutt. as well as several Old World species.

O. ixodes, f. ecaudata Butters & Abbe, Rhodora **45:** 4. Thunder Bay Dist., Ont. (North Fowl Lake), BABs 682.—Isolated on a single slate cliff; locally abundant.

Vicia americana Muhl. *ex* Willd. Brule River, F. F. Wood (Jul. 2, 1891); Mountain Lake, BBsH 24; John Lake, BM 10797; North Fowl Lake, BABs 666; South Fowl Lake, BsH 302; Grand Portage, Be 505, S. Brown 22; Mineral Center, BR 4568.—Clearings, cliffs, burnt-over slopes, old trails; occasional.

V. americana, var. truncata (Nutt.) Brewer. John Lake, BM 10797a.—Cliff. All of the material of the species from Cook Co. has elliptic leaflets, unlike the material from the vicinity of the Twin Cities, but there are all intermediates between the two extremes. It is doubtful whether this variety is tenable.

Lathyrus japonicus Willd., var. glaber (Ser.) Fernald, Rhodora **34:** 181. Grand Portage, S. Brown (1935), R 7900; Grand Marais, R 5971; Poplar River, T. S. Roberts (Aug. 7, 1879); Temperance River, SS 6034.—Shore of Lake Superior, especially sand and shingle beaches, but becoming a roadside weed in the vicinity of the lake.

This species occurs not only along the north shore of Lake Superior, but also at Lake of the Woods and Lake Winnipeg. Its presence at the last two localities suggests the thought that it perhaps spread along the shores of Lake Agassiz.

N. C. Fassett (Torreya **42:** 180) has recognized a form (f. *spectabilis*) of this variety which he reports from Grand Marais.

L. venosus Muhl., var. intonsus Butters and St. John, Rhodora **19:** 158. South Fowl Lake, BM 10839.—Top of bluff.

L. ochroleucus Hook. Watab Lake, BBl 433; Mountain Lake, BsH 13; South Fowl Lake, BsH 304; Pigeon River, BR 4552; Grand Portage, Be 519.—Cliffs, portage trails, aspen woods. Common throughout the wooded part of the state, not in the prairie region. It seems to favor fairly acid soil and thus is not found on the gray drift in the state.

OXALIDACEAE

Oxalis montana Raf. *cf.* Fernald, Rhodora **22:** 144. Kimball Creek, R 2606; Northern Light Lake, BA 767; Grand Marais, L. S.

Cheney (June 20, 1891); Cascade River, T. S. Roberts (Aug. 2, 1879).—Deep mossy cedar swamps and other woods; infrequent.

GERANIACEAE

Geranium Bicknellii Britton, *cf.* Fernald, Rhodora **37:** 296. Rhodora **43:** 35; Weber, Rhodora **44:** 91. Sawbill Lake, Bg 75; Loon Lake, D 168; Clearwater Lake, BA 216; Brule River, E. Loula 5; "Pike Lake" F. F. Wood (Aug. 1889); Lima Mountain, BA 883; South Fowl Lake, BM 10837; Royal River, BsH 351; Grand Portage, BAA 456, SS 12029; Mount Josephine, BA 162; Mt. Rose, SS 6065; Hovland, Be 617.—General in dry habitats. This appears to be the typical material with the long and short hairs intermixed on the pedicels.

POLYGALACEAE

Polygala paucifolia Willd. (North) Brule River, E. Loula 6; Pigeon River, BR 4611.—Forest; locally abundant. This species has a curious distribution, being quite northern in Minnesota, but in general is not so, occurring at sea level to Baltimore and in the mountains to Georgia.

CALLITRICHACEAE

Callitriche palustris L. Cross River, R 6388; Poplar Lake, R 5444; Otter Lake, BA 803; Clearwater Lake, BA 944; Grand Portage, Be 497, Be 654, R 6276; Mineral Center, BA 212; Grand Marais, Conway MacMillan (July 1900); Mark Creek, C. B. Reif A20.—On moist ground of trails and wet mud or muck of stream and lake banks or bottoms, sometimes in lakes, sometimes in streams. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) from practically all of the streams and rivers which are on the Lake Superior watershed in Cook County.

EMPETRACEAE

Empetrum nigrum L. Belle Rose Island, G. B. & F. Ownbey 1070.—"forming mats on moist ledge."

The plants of this collection are a close match vegetatively for F. J. Hermann 8196 (Eagle Harbor, Keweenaw Co., Mich.) and E. I. Roe, s. n., Oct. 20, 1929 (Pictured Rocks, Marquette Co., Mich.) and for eastern arctic and subarctic collections. The leaves of the older twigs are sharply reflexed; the twigs, including those of the year's growth, are glabrous except for short-stalked glands and the presence of an occasional simple hair. The bud scales are arachnoid pubescent along their margins, but the foliage leaves have glandular hairy margins only. The Ownbey collection cited above was made Aug. 14, 1948 and bears fully ripe berries which at the time of collection were "about 8 mm. in diam., deep purple-black," and in the pressed condition are glossy blue-black.

This collection is notable as the first of this species which has come to our attention from Cook County. Previously collected material in the Herbarium of the University of Minnesota all falls in the following species.

E. atropurpureum Fernald & Wiegand, Rhodora **15:** 214. Belle Rose Island, OO 1073; Susie Island, R 6036, R 6057, OO 1047; Lucille

Island, N 1659; Long Island, BAA 463, AA 517; Sailboat Island, AA 539, S 6007.—On rocky islands of the Grand Portage area; very local.

Fernald's report (Gray's Manual of Botany, ed. 8, 975) of *E. nigrum* from "n. Minn." is presumably based on material of *E. atropurpureum*, whose presence he does not recognize in Minnesota. However, when he and Wiegand originally described *E. atropurpureum* they said (*op. cit.*, p. 215) that "sterile specimens from Passage Island, Lake Superior (*W. S. Cooper, no. 107*[15]) may belong here." A study of the suite of collections cited above and of our Isle Royale specimens (*Cooper 390; Wheeler 689*) shows but little difference from authentic material cited by Fernald and Wiegand[16] (*op. cit.*). These all have in common the lanate white pubescence of the twigs, and a fringe of similar pubescence on the edges of the leaves; the leaves of the older twigs are but rarely reflexed, more commonly being loosely spreading. However, the Isle Royale and Cook County representatives of this species have occasional short-stipitate glands intermixed with the long lanate pubescence of the twigs. The fruits of these westernmost representatives of this eastern species have been collected but once in a completely ripe state (*Schuster 6007*) on September 8; the field notes indicate that they were "dull purplish" when collected and 6 mm. in diameter. In the dry state they are a dull bluish-purple, in marked contrast to the larger blue-black fruits of *E. nigrum* collected in the same area. Equally striking is the discrepancy of some three weeks in the time of maturation of the fruits in the two species. The Ownbeys collected *E. atropurpureum* and *E. nigrum* on the same island and on the same day (August 14); the fruits of *E. atropurpureum* are immature, pink and but 4 mm. in diameter while those of *E. nigrum* are dead ripe.

ANACARDIACEAE

Rhus radicans L. (*sens. lat.*).—Seen but not collected. Almost invariably associated with *Parthenocissus inserta*, sometimes so closely that the branches of the two intertwine. Our notes indicate that we have observed it on warm talus slopes below the cliffs of Watab Lake, Royal Lake, and in the Thunder Bay District on the east side of North Fowl Lake. It is rumored to occur sporadically along the portages of the old canoe route along the International Boundary. D. M. Stewart has told us of a patch on Lima Mountain and another at West Pike Lake.

CELASTRACEAE

Celastrus scandens L. Thunder Bay District, Ont. (North Fowl Lake), BABs 696.—Slaty talus slope.

Not yet collected in Cook Co., but to be expected. At this station it was associated with *Parthenocissus inserta*, poison ivy and *Lonicera dioica*, var. *glaucescens*.

[15] This is the number of the specimen in the Gray Herbarium, Cooper having renumbered the specimens which he sent there. It lies in the collections of the Herbarium of the University of Minnesota under its original field number—390.

[16] M. L. Fernald 277, Squaw Mountain, Piscataquis County, Maine, July 9, 1895; M. L. Fernald, s. n., Ledges, no. face of Boarstone Mt. (alt. 2000 ft.), Piscataquis County, Maine, Aug. 16, 1895; both sheets in Herb. Minn.

ACERACEAE

Acer spicatum Lam. Sea Gull Lake, L 3692; Poplar Lake, D 19; Canoe Lake, BsH 379; John Lake, BM 10796; North Fowl Lake, BABs 661; Grand Portage, Be 509, Be 567; Kimball Creek, R 2610; Grand Marais, BBl 478; Tofte, L 4839.—Common throughout.

A. saccharum Marsh. Mineral Center, BR 4595, Be 694, BA 190.—Rare in Cook County.

At the locality cited above there is a sugar-bush some acres in extent with the characteristic species associated with hard maple further to the south. Some of these species are *Maianthemum canadense* var. *interius*, *Polygonatum biflorum*, *Smilacina racemosa* and *Betula lutea*. This sugar-bush is evidently a post-glacial relic stand, occurring as a well-preserved community on a moraine several miles inland from Lake Superior. It is of considerable interest since here in Cook County we find almost side-by-side with this relic of a more southern flora, arctic and sub-arctic species in the habitats appropriate to them, notably the cool, moist, open, north-facing cliffs of the nearby border lakes or on the low islands in the cold water of Lake Superior. A striking feature about the sugar-bush as a relic occurrence is that a whole association is here represented, while the arctic species occur as sporadic individuals. The sugar-bushes in the north are surely to be considered as post-Wisconsin relics, and by their presence present powerful evidence of the existence of post-Wisconsin climatic fluctuations which permitted the movement of whole communities.

The localization of *Acer saccharum* within Cook County (it is reported by D. M. Stewart in conversation as also occurring in the county elsewhere at the edge of the upland) seems to be related to its sensitiveness to frost, especially the young leaves. Along the lakeward edge of the upland in Cook County there is good air drainage, which should reduce the chances of spring and summer frosts such as occur inland. And along the lake shore there is a consistently low average air temperature which is likewise unfavorable to the growth of *A. saccharum*. In other words it is only at the edge of the Cook County upland that the sufficiently long frost-free growing season which will permit the survival of this species is to be found.

A. rubrum L. Lima Mountain, BA 869, D. M. Stewart (Sept. 15, 1944).—Rare and local.

BALSAMINACEAE

Impatiens capensis Meerb. *I. biflora* Walt. Sawbill Lake, Bg 76; Poplar Lake, BA (sight record, 1944); Hungry Jack Lake, BR (Aug. 1934), BAA 331a; West Pike Lake, BsH 185; Grand Portage, Be 650, Be 653, R 7904.—Common everywhere in moist places.

RHAMNACEAE

Rhamnus alnifolia L'Hér. Sea Gull Lake, L 3633; South Fowl Lake, BABs 652; Pigeon River, BR 4559.—Roadsides and open woods; infrequent. D. M. Stewart tells us that it is common along the North Brule River and on the west side of Swamp Lake.

Ceanothus americanus L. Grand Marais, H. W. Slack (Jul. 1892).—Not recently observed in the county.

VITACEAE

Parthenocissus inserta (Kerner) K. Fritsch. *P. vitacea* (Knerr) Hitchcock. Watab Lake, BA 112; South Fowl Lake, BsH 314; Royal Lake, BsH 332; Thunder Bay Dist., Ont. (North Fowl Lake) BABs 700.—Talus slopes; infrequent. Regularly growing in association with *Rhus radicans*. Neither plant is common in the region, and both grow in profusion where they do occur, both as low plants, scrambling over talus slopes.

TILIACEAE

Tilia americana L.—Reported by D. W. Jenkins (*in litt.*, 10 Sep. 1948) as growing at Illgen City.

GUTTIFERAE

Hypericum majus (A. Gray) Britton. Sawbill Lake, Bg 73, Bg 74; Loon Lake, BR 6521; Lima Mountain, BA 690; Schroeder, BA 1067, O 984.—Stream margins, roadside ditches.

H. virginicum L., var. Fraseri (Spach) Fernald, Rhodora **38:** 434. Sawbill Lake, Bg 72; Hungry Jack Lake, BR 6356; Grand Portage, BA 970; Temperance River, C. B. Reif A10.—Edges of ponds, or even in 6 in. of water in river.

VIOLACEAE

Viola cucullata Ait. Grand Portage, S. Brown 4, BM 10874; Mineral Center, BR 4589, BA 194; Brule River, BR 4538.—Moist woods and stream margins. BA 194 and BM 10874 are f. *prionosepala* Brainerd.

V. Selkirkii Pursh. Kimball Creek, R 2602.—Shaded ravines. This has also been collected in quantity near Duluth.

V. pallens (Banks) Brainerd. Sea Gull Lake, L 3667; Loon Lake, BR 6518; Poplar Lake, R 5443, R 5446; Hungry Jack Lake, BR 6354; Clearwater Lake, BA 109; Mountain Lake, BAA 290, BAA 330; MacFarland Lake, BBl 341; North Fowl Lake, BABs 653; Pigeon Point, N 1639; Porcupine Island, AA 584; Susie Island, R 6034; Lucille Island, N 1647, BAA 354; Long Island, AA 544; Grand Portage, R 6024, BR 6277; Brule River, BR (Jul. 1, 1924); Devil's Track River, T. S. Roberts (Aug. 21, 1879); Carribeau River, BR 4496.—Moist woods, sphagnum bogs, moist rocks; very common.

BAA 354 and AA 544 are placed here with considerable hesitation; the plants have cordate leaves, 1½–3½ cm. long, which are rather acute with glabrous blades and bristly pubescent petioles; the peduncles of some cleistogamous flowers are prostrate, some are erect; the ripe seeds are 1½ mm. long, and dark brown (!).

V. incognita Brainerd. Sea Gull Lake, L 3655, L 3704; Gunflint Lake, BBl 385a; Poplar Lake, BA 843; Watab Lake, BA 219; Clearwater Lake, N 1696; Mountain Lake, BAA 300, BBsH 27; East Pike Lake, BsH 221; Mineral Center, BR 4578, Be 689; Grand Marais, BA 764.—Moist woods, portage trails, etc.; common.

BsH 221 is possibly a hybrid with *V. renifolia*. It has the leaf shape of *V. incognita*, and the upright growth of that species, but the underground parts are intermediate. The cleistogamous flowers more nearly resemble those of *V. renifolia*.

V. RENIFOLIA A. Gray.

—*typical form with leaves pubescent above:* Poplar Lake, L. W. Orr 19; Mountain Lake, BsH 175.

—*towards* var. BRAINERDII, *with a few hairs along the veins above:* Mountain Lake, BBsH 54.

—var. BRAINERDII (Greene) Fernald, RHODORA **14:** 88; *hairy on petioles and along veins of leaves on under side:* Sea Gull Lake, L 3668, L 3686; Gunflint Lake, BBl 385; Clearwater Lake, BR 6367, N 1706, BA 94, BBsH 1, BsH 162, BA 956; Little Caribou Lake, BsH 402; Mountain Lake, BAA 236, BAA 247, BAA 254; John Lake, BM 10782.

—*leaves glabrous below but ciliate on petiole and base of leaf:* Hungry Jack Lake, BAA 335; Clearwater Lake, BR 6365; Mountain Lake, BBsH 25, BBsH 79.

—*leaves wholly glabrous on both sides and on the petioles:* Clearwater Lake, N 1695, Butters & Wherry (Jun. 29, 1935); Mountain Lake, BBsH 28, BBsH 127.—Moist woods; general.

V. PENSYLVANICA Michx., var. LEIOCARPA (Fern. & Wieg.) Fernald, RHODORA **43:** 616. Grand Portage, S. Brown (1935); Mineral Center, BR 4588; Hovland, BR 4629.—Moist hardwoods; not common.

V. ADUNCA J. E. Smith

—*normally pubescent:* Watab Lake, BAA 227; Clearwater Lake, N 1708, BBl 417; Little Caribou Lake, BsH 401; Pigeon Point, BAA 430 (some plants nearly glabrous); Clark's Bay, BAA 395; Morrison Bay, BBl 359; Grand Portage, NBr 3229a, BM 10869; Mount Josephine, BR 6324, BA 169; Brule River, NBr 3220; Thunder Bay Dist., Ont. (North Fowl Lake) BABs 687.

—*slightly pubescent to nearly glabrous:* Clearwater Lake, Butters & Wherry (June 29, 1935), BA 75; Mountain Lake, BBsH 143; Lima Mountain, BA 887; South Fowl Lake, BM 10826; Pigeon Point, BAA 408.

—var. GLABRA Brainerd. Sea Gull Lake, L 3638; Morrison Bay, R 6055; Tofte, L 4836.

—var. MINOR (Hook.) Fernald, RHODORA **51:** 57. *V. labradorica* Schrank. Grand Portage, BR 6293. Cliffs of the Border Lakes, shore rocks of Lake Superior, sphagnum bogs; general. In Cook County there is a complete series from the usual retrorsely, finely pubescent form to var. *glabra*. The later leaves are usually more pubescent than the earlier ones.

V. TRICOLOR L. Grand Portage, Be 680.—An established adventive. This small-flowered pansy is only somewhat improved by cultivation over the wild Johnny-Jump-Up, and is a far cry from the lushly luxuriant pampered plush-petalled pansy of our modern gardens. It seems to be the typical phase, coming very close to var. *vulgaris* Koch (*cf.* Hegi, Ill. Fl. Mitteleur., vol. 6: 602).

It has been growing with a minimum of cultivation in the Grand Portage area for at least a century. According to Mrs. J. McLean, long-time resident and post-mistress of Grand Portage, it was transplanted to Susie Island about 1905 by Mrs. E. Falconer, wife of a pioneer mine operator. She found it growing without cultivation on the site of the old, abandoned Parker farm on the U. S. side near the mouth of the Pigeon River. The Parkers are said in turn to have obtained it in the 1850's from the garden of the Hudson's Bay Company outpost which became the site of the Parker farm. How long before this it was introduced is an open question.

ELAEAGNACEAE

Shepherdia canadensis (L.) Nutt. North Fowl Lake, BABs 664; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 688.—Talus slopes and open pine woods; very uncommon in the state as a whole.

ONAGRACEAE

Epilobium angustifolium L. Sawbill Lake, Bg 70; Rove Lake, L. S. Cheney (July 15, 1891); Long Island, AA 552; Grand Portage, Be 487, S. Brown (1935).—Roadsides. AA 552 is the wide-leaved phase.

E. leptophyllum Raf. *cf.* Fernald, Rhodora **46:** 382. Clearwater Lake, N 1691; Grand Portage, BA 965; Cascade, BA 754; Schroeder, BA 1057.—Edge of the lakes and ponds, roadside ditches.

E. palustre L. Susie Island, OO 1046.—Sphagnum bog. A broad-leaved phase.

E. glandulosum Lehm., var. adenocaulon (Hausskn.) Fernald, Rhodora **20:** 35. Sawbill Lake, Bg 3, Bg 69; West Bearskin Lake, BR 6363; Clearwater Lake, BA 954; Lima Mountain, BA 892; West Pike Lake, BsH 198; Porcupine Island, OO 1049; Belle Rose Island, OO 1060; Grand Portage, Be 538, Be 612, Be 627; Hovland, Be (Aug. 22, 1929).—Roadsides, old trails, moist areas near springs.

Oenothera biennis L. Grand Marais, T. S. Roberts (Aug. 1879).

O. biennis, var. hirsutissima Gray. *O. strigosa* (Rydb.) Mack. & Bush. Hungry Jack Lake, BsH 420; South Fowl Lake, BsH 324; Royal Lake, BsH 272.—Cliffs, sometimes locally abundant.

O. parviflora L. *O. muricata* L. West Pike Lake, BsH 200; Cascade, BA 761; Thunder Bay Dist., Ont. (Pigeon Bay), AA 601.—Dry and sunny talus slopes and cliffs, old gravel beaches.

O. perennis L. *cf.* Munz, Bull. Torrey Bot. Cl. 64: 302. Granite River, L. S. Cheney (July 20, 1891); Pigeon River, BR 6270.

Circaea alpina L. Sawbill Lake, Bg 68; Poplar Lake, L. W. Orr 11; Leo Lake, BAA 334; Alder Lake, BBl 476; Mountain Lake, BAA 302, BBsH 88; West Pike Lake, BsH 202; Royal Lake, BsH 234; Pigeon River, L. S. Cheney (July 9, 1891); Mineral Center, Be 657; Grand Portage, BA 968; Kimball Lake, E. Loula 14.—Portage trails, wooded valleys, moist woods; general.

HALORAGACEAE

Myriophyllum alterniflorum DC., var. americanum Pugsley, Jour. Bot. 76: 51. Poplar Lake, BA 838; "Bearskin Lake," U. S. F. S. (Aug.

28, 1935); Temperance River, C. B. Reif A4.—Sand or rock bottomed streams; locally abundant. Reported as *M. alterniflorum* by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, 134) from the Cross and Temperance Rivers.

M. EXALBESCENS Fernald, RHODORA **21:** 120. East Pope Lake, "L. W. K." 16.

Reported by Smith and Moyle (*loc. cit.*) from the Devil Track River; they characterize it (*op. cit.*, p. 139) as rare.

HIPPURIDACEAE

HIPPURIS VULGARIS L. Grand Portage, BA 966.—Shallow pool.

Reported by Smith and Moyle (*loc. cit.*) from the Cross, Poplar, Cascade, Devil Track and Brule Rivers. These authors do not distinguish the following variants.

H. VULGARIS, f. FLUVIATILIS (Cosson & Germain) Glück. Otter Lake, BA 802; Baldy's Creek, C. B. Reif A32.—Slow stream; occasional.

H. VULGARIS, var. RHAETICA (Zschokke) Gremli *cf.* H. Glück *in* Pascher's Süsswasser-Flora Mitteleuropas 15: 339. Loon Lake, BR 6516; Grand Portage, BR 6294; Grand Marais, L. S. Cheney (June 29, 1891).—Shallow streams, pools. Hegi (Fl. Mittel-Eur., V, 2: 906) refers this to "f. *Raetica* (Zschokke) Gremli." Since we have not been able to locate the original publication of the name, its spelling and authorization remain uncertain.

This diminutive-leaved phase is probably worthy of formal rank only, especially since Hegi (*op. cit.* p. 907) states that H. Schinz found that it returned to f. *typica* when transplanted to Zürich (from Graubünden). Our plants are but 10–16 cm. long, with leaves 4–6 mm. long and 0.3 to 0.5 mm. wide. Since some of the specimens are fruiting there seems to be no question of the plants being mature. It seems to be the commoner form of the species in the county.

ARALIACEAE

ARALIA RACEMOSA L. Hungry Jack Lake, BR 6332, BBl 452.—Very uncommon.

A. HISPIDA Vent. Sawbill Lake, Bg 67; Hungry Jack Lake, BsH 418; Poplar Lake, D 103; Rove Lake, BBsH 106; Pigeon Point, N 1622; Magnet Island, BR 6237; Little Brick Island, OO 1079; Susie Island, AA 560, OO 1043; Grand Portage, R 5989, Be 630; Hovland, BR 4635.—Dry rocks of cliffs and islands.

A. NUDICAULIS L. Sea Gull Lake, L 3615; Poplar Lake, D 48; Clearwater Lake, BA 55; Grand Portage, Be 560.—Abundant in forests throughout the region.

UMBELLIFERAE

SANICULA MARILANDICA L. Mountain Lake, BAA 331, BBsH 23; John Lake, BsH 269; Grand Portage, Be 520; Hovland, BR 4633.—Clearings, wet woods, portage trails; occasional.

OSMORHIZA CLAYTONI (Michx.) Clarke. Mineral Center, BR 4590.—Isolated stand of hard maple; very local.

This is distinctly a plant of the hardwood forests of central and southern Minnesota.

O. obtusa (Coult. & Rose) Fernald, Rhodora **4:** 153. Watab Lake, BA 108, BBsH 114; Mountain Lake, BAA 303; Royal Lake, BM 10851.—Moist woods and thickets; local and rare.

This is one of the distinctly western species which has also been found about the Gulf of St. Lawrence. It adds another to the long list of plants which find intermediate stations on the Upper Great Lakes.

Zizia aptera (Gray) Fernald, Rhodora **41:** 441. Mineral Center, BR 4562; Schroeder, BA 1080.—Roadsides; infrequent.

Carum Carvi L. Susie Island, BBl 347; Grand Portage, BM 10882.—Near houses and along roadsides; adventive and established. Also noted but not collected in the village of Grand Marais where it is a common weed, and again along the highway ten miles to the west.

Sium suave Walt. *S. cicutaefolium* Schrank *cf.* Blake, Rhodora **17:** 131. Sawbill Lake, Bg 66; Gunflint Lake, BR 6387; Birch Lake, D 66; Devil's Track River, T. S. Roberts (Aug. 18, 1879); Cascade River, C. B. Reif A18; Temperance River, C. B. Reif A27.—Lake shores and shallow streams; locally abundant to scarce. Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) report it from the Temperance, Poplar, Cascade, Devil Track and Brule Rivers.

Pastinaca sativa L. Susie Island, OO 1136; Grand Portage, S. Brown (1935).—Weed in clearing. Ownbey says of his 1136 "apparently becoming naturalized at this site and at other localities on [Susie] island."

Heracleum maximum Bartr. *H. lanatum* Michx. Grand Portage, Be 578.—Ubiquitous in moist places; reaches a height of 8 feet.

CORNACEAE

Cornus canadensis L. Sea Gull Lake, L 3613; Sawbill Lake, Bg 65; Poplar Lake, L. W. Orr 13, D 13; South Fowl Lake, BABs 618; Royal River, BsH 290; Pigeon Point, N 1627; Grand Portage, Be 500, S. Brown 15; Hovland, OO 1004; Poplar River, T. S. Roberts (Aug. 6, 1879).—Roadsides, portage trails, fir-birch-poplar woods; frequent.

C. stolonifera Michx. Poplar Lake, L. W. Orr 16; South Fowl Lake, BABs 647; Pigeon Point, B (Sep. 3, 1927); Susie Island, OO 1123; Grand Portage Island, R 6032; Tofte, R 7836, R 7837, R 7850.—Beach margins, moist openings and thickets.

C. stolonifera Michx., var. Baileyi (Coult. & Evans) Drescher. Winchell Lake, BA 134; Rove Lake, BBl 426; South Fowl Lake, BABs 644, BABs 646; Clark's Bay, B (Sep. 3, 1927); Grand Portage, Be 501, Be 528, BR6217, S. Brown 23; Hovland, R 5460; Brule River, BR 4545; Grand Marais, R 5976; Lutsen, L 4786; Thunder Bay Dist., Ont. (Mountain Lake) BAA 312.—Beaches, stream banks, Norway pine woods, talus slopes, etc.

While Fosberg (Bull. Torrey Bot. Cl. **69:** 583) has reduced this variety to formal status under his *C. sericea*, it is surely worthy of consideration as a variety because it has a range quite different from that of *C. stoloni-*

fera, although overlapping with it. Dr. B. Lennart Johnson, who has made extended field and cytological studies (unpubl.) of this group, feels that on the basis of his evidence the varietal status is fully justified.

The two following collections are intermediate between *C. stolonifera* and *C. stolonifera* var. *Baileyi:*—Grand Portage, Be 565; Hovland, R 5460. In these collections the pubescence is in part loose, but much of it is also appressed.

C. RUGOSA Lam. Sea Gull Lake, L 3628; Hungry Jack Lake, BsH 421; Watab Lake, BAA 221; Little Caribou Lake, BsH 393; Mountain Lake, BBsH 71; West Pike Lake, BsH 194; East Pike Lake, BsH 225; John Lake, BM 10784; South Fowl Lake, BsH 320, BM 10835; Royal River, BsH 334; Mount Rose, R 7907; Carlton Peak, T. S. Roberts (Aug. 25, 1879); Thunder Bay Dist., Ont. (Pigeon Bay), AA 607.—Cliffs, talus slopes, pine woods.

C. ALTERNIFOLIA L. f.—Reported by Juni (*op. cit.*) from the Poplar River. D. M. Jenkins (*in litt.*, Sept. 10, 1948) mentions its occurrence at Hovland and Schroeder.

PYROLACEAE

CHIMAPHILA UMBELLATA (L.) Bart., var. CISATLANTICA Blake. Sea Gull Lake, BA 918; Sea Gull River, N 1678; Sawbill Lake, Bg 56; Granite River, F. F. Wood (Jul. 22, 1891); Poplar Lake, L. W. Orr 32, D 32, SS 6022; Birch Lake, D 59; Clearwater Lake, BsH 165; Lima Mountain, BA 888; Mountain Lake, BBsH 129; Northern Light Lake, BA 773; West Pike Lake, BsH 188; Royal River, BsH 331; Devil's Track Lake, T. S. Roberts (Aug. 16, 1879).—In woods along portage trails, tops of cliffs and hills, and stream banks; widely distributed but not particularly abundant.

MONESES UNIFLORA (L.) Gray. Sawbill Lake, Bg 63; Alpine Lake, L 3664; Gunflint Lake, SS 6010; Poplar Lake, L. W. Orr 31; Birch Lake, D 191; Partridge Lake, BA 801; Hungry Jack Lake, BAA 338; Rove Lake, L. S. Cheney (Jul. 16, 1891), BBsH 95; Mountain Lake, BBsH 79; Moose Lake, BAA 292; Royal Lake, BsH 237, BM 10853; Susie Island, OO 1029; Grand Portage, Be 697, F. K. Butters & E. Wherry (Jun. 30, 1935), S. Brown 36; Mineral Center, BR 4601; Grand Marais, T. S. Roberts (Jul. 31, 1879).—Moist woods and portage trails.

PYROLA SECUNDA L. *sens. lat.* Sawbill Lake, Bg 57; South Lake, L. S. Cheney (Jul. 18, 1891), F. F. Wood (Jul. 18, 1891); Watab Lake, BAA 232; John Lake, BM 10810; Grand Portage, Be 535, R 5988; Kimball Creek, BR 4670; Grand Marais, T. S. Roberts (Jul. 30, 1879); Black Point, T. S. Roberts (Aug. 24, 1879).—Fir-birch woods, portage trails, etc.

The Cheney-Wood collections are recorded above as for South Lake although the labels on their specimens give the locality as "South Fowl" and "South Ford" Lakes respectively. On the basis of a detailed itinerary derived from an analysis of the labels for their specimens in the Herbarium of the University of Minnesota, and from a knowledge of the country, the writers are convinced that Cheney and Wood were at South Lake on July 18, 1891 and that "South Fowl Lake" and also "South Ford Lake"

is to be considered as a *lapsus calami* on their respective parts, since vibration to this degree is sufficient to involve a three-day canoe journey in either direction. Unfortunately Cheney's published account (Wisc. Acad. Sci., Arts and Letters 9: 239) places their collection of this species at Rove Lake!

None of our specimens have thoroughly typical leaves, falling instead between the typical material with its more pointed and narrower leaves and var. *obtusata*.

P. secunda, var. obtusata Turcz. Clearwater Lake, BBl 399; Mountain Lake, BBsH 70; MacFarland Lake, BBl 333; Grand Portage, R 5998, R 6008.—Woods and cliffs.

This extreme is pretty well marked in leaf shape and grades toward the typical extreme, the average of which is not fully achieved in Minnesota.

P. minor L. Moose Lake, BAA 284; Pigeon Point, BAA 404; Susie Island, R 6033b.—Moist woods, bogs, and portage trails.

P. virens Schweigg. *P. chlorantha* Sw. *cf.* Fernald, Rhodora **43:** 167 *and* Rhodora **22:** 49. Sea Gull Lake, L 3636, L 3654; Sawbill Lake, Bg 59; Gunflint Lake, BBl 379; Poplar Lake, SS 6023; Watab Lake, BA 102, BAA 238, BBsH 14; Clearwater Lake, BR 6366, BA (Jun. 22, 1936), BBsH 3; West Pike Lake, BsH 159a; John Lake, BM 10803; Grand Marais, T. S. Roberts (Jul. 30, 1879); Black Point, T. S. Roberts (Aug. 24, 1879).—Moist cliffs and ledges, portage trails, white pine, birch, or balsam-fir woods.

P. virens, f. paucifolia Fern. Rhodora **43:** 167. Sea Gull Lake, L 3614; Gunflint Lake, BBl 387; Hungry Jack Lake, BAA 336; Clearwater Lake, BA 126a; Mountain Lake, BBl 539, BBsH 61; Grand Marais, N. L. Huff (Jul. 10, 1925); Carribeau River, BR 4516. Same habitat as the species, but less abundant.

This material is markedly variable, and, while it all falls reasonably well within the range of variation allowed by Fernald in his original description (Rhodora **22:** 51), there is a variety of combinations of characters represented by the various collections. Thus BA 126a and BAA 336 have small calyx lobes and fair-sized leaves, while others are almost completely aphyllous, as L 3614, or the much reduced leaves may be broadly orbicular instead of triangular flabellate (BBsH 61). The correlation between small calyx lobes and small leaves is none too perfect.

P. elliptica Nutt. Sawbill Lake, Bg 60; Hungry Jack Lake, BAA 337; Mountain Lake, BBl 440, BBsH 134; West Pike Lake, BsH 192; Grand Portage, Be 518, BAA 457.—Portage trails, cliffs and forest floor in moist white birch and balsam woods.

P. rotundifolia L., var. americana (Sweet) Fern. Rhodora **22:** 122. Sawbill Lake, Bg 55; Grand Portage, R 6070.—Infrequent; woods.

P. asarifolia Michx. (typical) *cf.* Fernald, Rhodora **6:** 178. Sea Gull Lake, L 3637; Sawbill Lake, Bg 58; Clearwater Lake, BsH 159; Mountain Lake, BAA 274, BBsH 120; South Fowl Lake, BsH 276, BsH 322, BM 10829; Royal River, BsH 356; Pigeon Point, BAA 405; Susie Island, BBl 351; Grand Portage, Be 557, BBl 369, BA 146, BA 209, BM

10870; Mount Josephine, BA 175; Mount Rose, S. Brown, 30; Grand Marais, L. S. Cheney (Jul. 1, 1891).—Portage trails, cliffs and forest floor in birch, poplar and balsam-fir woods.

Monotropa uniflora L. Sawbill Lake, Bg 64; West Pike Lake, BsH 209; Poplar Lake, D 93a; Birch Lake, BA 823; Brule River, E. Loula 23; Royal River, BsH 289; Susie Island, OO 1021; Grand Portage, Be 658; Mineral Center, Be (Aug. 22, 1929); Hovland, OO 1005.—Moist woods and portage trails; rather common.

M. Hypopithys L. Hovland, R. M. Schuster (Sept. 1, 1947, sight record in bog at edge of Bog Bay); Carlton Peak, T. S. Roberts (Aug. 25, 1879).—Rare.

ERICACEAE

Ledum groenlandicum Oeder. Sea Gull Lake, L 3691, BA 907; Cross River, BA 914; Brule River, E. Loula 4; Birch Lake, BA 822, D 58; Poplar Lake, D 102; Pigeon Point, BBs 728; Lucille Island, BAA 342; Grand Portage, Be 614, S. Brown 45, BM 10881; Reservation River, BR 4574; Grand Marais, BR 4648.—Spruce-tamarack swamps, sphagnum bogs, jack-pine woods; locally abundant, but not general.

Kalmia polifolia Wang. Sea Gull Lake, L 3669; Moose Lake, BAA 283; Grand Portage, Be 700; Schroeder, NBr 3201.—Sphagnum bogs.

Andromeda glaucophylla Link. Sea Gull Lake, BA 906; Long Island, BAA 467, AA 520, OO 1109; Grand Marais, L. S. Cheney (Jun. 24, 1891); Schroeder, NBr 3200.—Except in the acid rock area of Cook County it is infrequent because of the limited number of sphagnum bogs.

Chamaedaphne calyculata (L.) Moench. *sens. lat.* Sea Gull Lake, L 3706, BA 913; Otter Lake, BA 796; Birch Lake, D 54; Poplar Lake, D 86, D 108; Susie Island, N 1652; Lucille Island, OO 1108; Porcupine Island, BR 6245, OO 1051; Sailboat Island, OO 1098; Grand Portage, Be 636; Schroeder, NBr 3202.—Infrequent as compared with its occurrence in the counties further west, because of the relatively restricted number of sphagnum bogs in Cook Co.

Epigaea repens L. Sawbill Creek, D. M. Stewart (Oct. 23, 1944).—Logged-over white pine woods; rare.

Mr. D. M. Stewart, who has had much field experience in Cook County in connection with his position in the U. S. Forest Service, says on the label of the above collection, "Not common in Cook County to my knowledge." The writers had noted the apparent absence of *Epigaea* and looked for it throughout each field season, without success.

Gaultheria procumbens L. Sea Gull Lake, BA (sight record only).—Rare.

G. hispidula (L.) Bigel. *Chiogenes hispidula* (L.) T. & G. Sea Gull Lake, L 3652; Sawbill Lake, Bg 61; Poplar Lake, L. W. Orr 14, BAA 326a; Clearwater Lake, BA 126; Pigeon Point, N 1636; Porcupine Island, BR 6241; Grand Portage, R (Aug. 12, 1929), BR 6302; Devil's Track River, T. S. Roberts (Aug. 15, 1879).—Portage trails, sphagnum bogs, spruce-tamarack swamps, cedar forest and balsam woods; very common.

Arctostaphylos Uva-ursi (L.) Spreng. (typical). *cf.* Fernald and Macbride, Rhodora **16:** 211. Sea Gull Lake, L 3707; West Bearskin Lake, D 144; Pigeon Point, B (Sep. 3, 1927), BR 6229, NBr 3234a; Mount Josephine, BR 6318, BA 1045.—On acid rocks of hills and lake shore.

A. Uva-ursi, var. coactilis Fern. & Macbr., Rhodora **16:** 212. Pigeon Point, R 6057, BR 6226, BBs 725; Susie Island, BBl 3512, AA 561; Long Island, AA 515, AA 516; Grand Portage Island, R 6030a; Mount Josephine, BA 189.—On acid rocks of hills and lake shore. AA 516 is the narrow-leaved phase, and AA 515 the broad-leaved phase. The pubescence of BA 189 is rather long.

A. Uva-ursi, var. adenotricha Fern. & Macbr., Rhodora **16:** 213. Watab Lake, BA 101; North Fowl Lake, BABs 667; Pigeon Point, R 6080, BR 6227.—Perhaps not as calcifuge as the typical material and var. *coactilis.*

Vaccinium uliginosum L. *sens. lat.* Long Island, AA 507; Grand Portage, L. S. Cheney (Jul. 4, 1891).—Near or on the shore rocks of Lake Superior; very rare, not known elsewhere in Minnesota. Cheney's material has small, broadly oblanceolate leaves, pedicels in abundantly flowering material 1–2 mm. in length, leaves 7–14 mm. long and 3–8 mm. wide, leaves slightly pubescent (less so than AA 507), stamens smaller than in AA 507 but with ascending appendages as long as or slightly longer than the tubules.

AA 507 has leaves varying from broadly oblanceolate to broadly obovate, pedicels of the half-ripe, dried up fruits 3.5 or more commonly 4.5 mm. long, leaves 1.2 to 3 cm. long and 7–21 mm. wide, leaves puberulent below, appendages of the anthers longer than the tubules and ascending. An erect shrub, 2–3 ft. high.

Four different collections in the Herbarium of the University of Minnesota from Isle Royale also exhibit a wide range of variation in this species. The leaves vary in length from 6–18 mm. and in width from 3–10 (15) mm. The pedicels in flowering material are from 1.5–4 mm. long and in fruit are rather uniformly 5–5.5 mm. long. The stamens have ascending appendages which are slightly shorter than, to equal in length to the tubules. The leaves and twigs are strongly puberulent in all four of the collections, being a little more so than in most of the European material available (some of which is even glabrescent), but finds a match in some Scandinavian specimens.

Each of the characters, namely, position and relative length of the appendages, size of stamens, size and shape of leaves, relative puberulence of under side of leaves and of young twigs, habit of plant—appears to vary practically independently of the others (*cf.* Fernald Rhodora **25:** 25). At present it is impossible to say which of these characters vary in response to environmental differences and which in response to genetical constitution. Obviously, for the material from northwestern Lake Superior, Malte's key (Rhodora **36:** 184) is not particularly useful since his major differentiation is based on leaf size, a respect in which our

material varies greatly. Until a great deal more material from all parts of the enormous range of this plant has been studied it seems futile to assign our specimens to any one named variety. This is especially the case because it is an extremely rare plant in our region, each collection representing a different individual with a different combination of characteristics, one, AA 507, having the largest leaves of any of the sheets from Europe or America in the Herbarium of the University of Minnesota.

V. CESPITOSUM Michx. Poplar Lake, R 5435; Watab Lake, BAA 224; Clearwater Lake, BA 85; Mountain Lake, BBsH 76; John Lake, BM 10799; South Fowl Lake, BM 10838.—Cliffs, talus slopes, bluffs, morainal ridges; infrequent, occurring only as a few individuals at each of the stations listed. Our material agrees well with the long-tubed and long-appendaged eastern material in contrast to the western material which appears on casual examination to have shorter tubes and the appendages somewhat shorter than the tubes.

V. MYRTILLOIDES Michx. *V. canadense* Kalm. Poplar Lake, D 4, D 63, D 65; North Fowl Lake, BABs 673; Pigeon Point, BBs 730; Porcupine Island, BR 6244; Grand Portage, Be 583, S. Brown 21, R 7864; Mount Josephine, BR 6328; Grand Marais, BR 4649, BA 47, BM 10770.

V. ANGUSTIFOLIUM Ait. Sea Gull Lake, L 3708; Poplar Lake, D 105; Clearwater Lake, N 1714; Pigeon Point, NBr 3233a, BBs 729.—Cliffs, dry woods and shore rocks; abundant locally, chiefly on the more acid sites.

V. VITIS-IDAEA L., var. MINUS Lodd. *cf.* Fernald, RHODORA **4:** 231. Brule River, R 5458; Pigeon Point, BR 6251; Porcupine Island, BBs 748, OO 1009; Susie Island, B (Sep. 2, 1927), R 6038, BBl 354, AA 566; Lucille Island, N 1651, BAA 343, BAA 344, BAA 381; Long Island, BAA 466, AA 523; Grand Portage, Be 696; Hovland, BR 4572; Grand Marais, BR 4646, N. L. Huff (Jul. 9, 1925), BM 10773.—Ledges, rocks within and at edge of spruce-tamarack and spruce woods; locally very abundant although decidedly limited in occurrence.

BAA 344 from Lucille Island and BBl 354 from Susie Island, the latter with branches up to 2.4 dm. and the former with branches from 1.3 to 1.5 (rarely 2.0) dm. high, represent the upper extreme in the range of variation of the American variety, being more similar in habit to the bulk of the European (especially Scandinavian) material in the Herbarium of the University of Minnesota than to the rest of the American material. Both collections also have leaves larger than usual, BAA 344 having them up to 1.9 (rarely 2.0) cm. in length, and up to 8.0 (rarely 8.5) mm. in width, while BBl 354 tends to be about 1 mm. less in its leaf dimensions. The leaves are thick like the other American rather than the European material. Most of the specimens from Cook County and the state are the dwarfed, microphyllous state of the variety.

While the large forms mentioned above were found on moist rocks, on the nearby tussocks of knee-deep sphagnum there occurred plants of the much dwarfed phase (represented by BAA 343), plants which appeared to be running a losing race with the encroaching sphagnum.

Some flowers of AA 566 are distinguished from the usual material by the presence of short, downward-pointing appendages which may be as much as 0.6 mm. long. It is not a consistent character and may be absent from other flowers within the same inflorescence. It is a condition occurring sporadically in both American and European plants but is not ordinarily illustrated or referred to—Gray's Manual (ed. 7), for instance, even characterizes the section *Vitis-Idaea* (p. 641) as having the anthers awnless. On the other hand, Bentham and Hooker (Genera Plantarum, vol. 2, pt. 2, 1876, p. 574) describe the anthers in this section as "dorso muticae v. breviter aristatae."

V. Oxycoccos L. Sea Gull Lake, L 3650, BA 908; Porcupine Island, BBs 745; Sawbill Lake, Bg 62; Belle Rose Island, OO 1066; Susie Island, N 1650; Grand Portage, Be 702, F. K. Butters & E. Wherry (Jun. 29, 1935), S. Brown 39; Hovland, BR 4573; Kelso Lake, E. Merritt (Jul. 1940).—Spruce-tamarack and cedar swamps, sphagnum bogs, exposed moist mossy areas on rocky shore islands; not common because of limited extent of favorable habitats.

PRIMULACEAE

Primula intercedens Fernald, Rhodora **30:** 86. Pigeon Point, BAA 429, BA 442, BAA 443; Clark's Bay, BR 6250; Porcupine Island, AA 571 (smaller form), AA 574 (larger form); Susie Island, B (Sep. 1927), R 6046, R 6062; Lucille Island, N 1665, BAA 345; Long Island, AA 511, AA 522; Sailboat Island, AA 540; Grand Portage, R 6029; Grand Marais, T. S. Roberts (Aug. 14, 1879), Lyon 924, BM 10771; Tofte, L 4775; Temperance River, SS 6026.—Moist rocks of the islands and shores of Lake Superior; locally fairly abundant.

In 1928 Professor Fernald (Rhodora **30:** 87), in establishing *P. intercedens*, stated that it "is here proposed without full confidence in its specific value." In his treatment he cites 16 collections from the Great Lakes region, including six from Minnesota and two from Isle Royale. Since then the amount of available material in the Herbarium of the University of Minnesota from the Minnesota shore of Lake Superior and from Isle Royale has increased to some 24 sheets, but the status of *P. intercedens* still remains uncertain.

The specimens of *P. mistassinica* from our whole series of *Primula* of Cook County may be easily segregated. There remains a somewhat heterogeneous residue. It is this residue which we refer to *P. intercedens*. While *P. intercedens* is always more or less farinose, some of our specimens (BAA 443 and Lyon 924) are conspicuously so; the majority must be examined with a hand lens to discover the farinosity (of a distinct lemon-yellow cast in dried specimens). In habit the well-grown plants which we refer to *P. intercedens* are somewhat stiffer and heavier than in *P. mistassinica*, have peduncles 1 mm. or more in diameter, and pedicels rather notably fastigiate. It shares with *P. mistassinica* the truncate teeth of the margins of the dehisced pods. As Professor Fernald has pointed out, the bracts of *P. intercedens* are generally more or less gibbous

("scarcely gibbous"), but sometimes they closely approach the *P. mistassinica* type in which the bracts are usually not at all saccate. Occasional plants of *P. mistassinica,* both from the Lake Superior region and elsewhere, have the bracts extremely saccate. The seed characters are also difficult to use—more so than the keys would suggest. While the seeds of *P. intercedens* are rather angular (when dry), they may be quite diverse in size and form even when derived from the same capsule. The rugose nature of the seed coat is very difficult to determine even under the high power of the binocular, and thus does not provide a very useful distinguishing character. In general the narrower and oblanceolate leaves of *P. intercedens* seem to set it off from *P. mistassinica.*

It would appear that Professor Fernald's observation that *P. intercedens* and *P. mistassinica* "have become much crossed" in the Great Lakes region is amply borne out by the additional circumstantial evidence that has come to hand in the past few years.

P. MISTASSINICA Michx. *cf.* Fernald, RHODORA **30:** 88. Clark's Bay, NE 2328, BAA 386; Porcupine Island, OO 1010; Susie Island, S 6045; Grand Portage, Butters & Wherry (June 29, 1935), S. Brown 38; Grand Marais, BR 4643, Butters & Wherry (June 28, 1935), BA 37, BA 38, BA 39, BA 40, BM 10775.—Crevices of rocks near the shore of Lake Superior, also peaty soil and in cedar bog; locally fairly abundant. It also occurs in Lake and St. Louis Counties along the shore of Lake Superior, and there is an isolated station for it at Stillwater on the St. Croix River in the southeastern part of the state.

BA 40 has the appearance of *P. mistassinica* as far as leaf shape, vesture and in other respects except that the bracts have rather deep pockets about a third of a millimeter in depth and the calyx is short, being about 3–3½ mm. in length. While the largest number of flowers in an umbel is indicated as 10 by Fernald (*loc. cit.*) the material from Stillwater has from 10–15 flowers in the umbels, the plants being relatively large as well.

LYSIMACHIA TERRESTRIS (L.) BSP. Sawbill Lake, Bg 54; Horseshoe Lake, L. W. Orr 28; Leo Lake, BR 6341; Alder Lake, BsH 387; South Fowl Lake, BsH 298; Royal River, BsH 261; Grand Portage, BA 989; Grand Marais, T. S. Roberts (Aug. 12, 1879).—Lake and pond shores.

L. THYRSIFLORA L. Sea Gull Lake, L 3705; Round Lake, C. B. Reif A10; Watab Lake, BAA 318; South Fowl Lake, BABs 622.—Wet, swampy shores; rather uncommon, probably because of a lack of suitable habitats.

TRIENTALIS BOREALIS Raf. Sea Gull Lake, L 3612; Poplar Lake, L. W. Orr 9, D 74; Clearwater Lake, Butters & Wherry (June 29, 1935), BA 59; South Fowl Lake, BABs 624; Susie Island, BBl 348; Grand Portage, Be 669, S. Brown 13; Grand Marais, T. S. Roberts (July 30, 1879), L. S. Cheney (June 20, 1891); Pike Lake, E. Loula 16.—Moist woods; general.

OLEACEAE

FRAXINUS PENNSYLVANICA Marsh. Gunflint Lake, BBl 372.—Sandy lake shore; not very common in Cook Co.

F. PENNSYLVANICA, var. SUBINTEGERRIMA (Vahl) Fernald. *F. pennsylvanica,* var. *lanceolata* (Borkh.) Sarg. Gunflint Lake, BBl 373.—Sandy lake shore; not very common in Cook Co.

F. nigra Marsh. Partridge Lake, BA 779; Loon Lake, BA 933; Grand Portage, Be 449.—Rather common.

Syringa villosa Vahl. MacFarland Lake, BM 10861.—Cultivated at Jameson's Lodge.

GENTIANACEAE

Gentiana rubricaulis Schwein. *cf.* Fernald, Rhodora **37:** 325. Alpine Lake, Winslow Briggs (Sept. 8, 1951); Cross River, L 4710; Schroeder, OS 988.—River bank.

Halenia deflexa (Sm.) Griseb. South Lake, BA 791; Lucille Island, OO 1094; Grand Portage, Be 512, BR 6305, BM 10864; Mount Josephine, N 1608; Kimball Creek, R 2607; Grand Marais, L. S. Cheney (June 26, 1891), MacMillan (July 1900); Tofte, L 4702; Temperance River, SS 6035.—Moist hill sides, grassy terraces, old woods roads; infrequent.

Menyanthes trifoliata L., var. minor Raf. Sea Gull River, N 1680; Sawbill Lake, Bg 53; Horseshoe Lake, BA 132; Partridge Lake, D 186; Long Lake, "L. W. K." (July 1936); Agnes Lake, L. W. Krefting 25; Grand Portage, SS 12034; Long Island, AA 500, OS 1112.—Bogs and pools.

APOCYNACEAE

Apocynum androsaemifolium L. (typical) *cf.* Woodson, Rhodora **34:** 30; *not* Woodson, Ann. Mo. Bot. Gard. 17: 86. Sawbill Lake, Bg 53; Poplar Lake, BAA 327; Clearwater Lake, BBl 434; Northern Light Lake, E. Loula 13; North Fowl Lake, BABs 659; Grand Portage, BM 10885.—Common in woods, on cliffs, and near habitations throughout the region.

CONVOLVULACEAE

Convolvulus spithamaeus L. *C. spithamaeus* var. *stans* (Michx.) Fogelberg, Trans. Wisc. Acad. Sci., Arts & Letters 30: 24. 1937. Sawbill Lake, Bg 52; North Lake, D. Lange 12; Cross River, BA 928; Poplar Lake, L. A. Koelnau 116; Mount Maud, BA 198.—Dry, sometimes burnt-over, slopes.

This densely hairy, dwarfed phase grades into the less hairy, often more elongate var. *pubescens* (Gray) Fern. The Cook County plants are excessively pubescent, 1–1.7 dm. high, the leaves rather closely crowded together, tending to fold lengthwise when pressed in contrast to var. *pubescens* which is a less pubescent (to nearly glabrous), taller (laxer) plant whose leaves are thinner and show less tendency to be folded lengthwise. We have not noted any tendency for the typical material to have the leaves more cordate at the base (*cf.* Fogelberg, *loc. cit.*), than in var. *pubescens*. Our material from Cook County fits into the northwestern part of the range shown by Wherry (Proc. Penn. Acad. Sci. 7: 163, fig. 19) for *C. "stans."*

HYDROPHYLLACEAE

Phacelia Franklinii (R. Br.) Gray *cf.* A. Brand, Pflanzenr. IV, 251, p. 109. Mountain Lake, BAA 296, BBsH 118; South Fowl Lake, BsH 323, BM 10820; Grand Marais, L. S. Cheney (June 25, 1891), Koelnau 110; Lutsen, NBr 3157; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 697.—Cliffs, wooded slopes; very local.

It is certainly not abundant in Minnesota, being known from but four localities in Cook Co. from Lake Vermilion, and from near Duluth, with a station in immediately adjacent Canada and on Isle Royale. Brand (*loc. cit.*), following R. Brown (Bot. App., p. 764 of Franklin's Journal, ed. 1), describes this species unequivocally as an annual. This appears to be doubtful since our specimens had already set an abundance of seed by July 6 and the beginning of growth in the area cannot be postulated as being earlier than the beginning of June. While there is no evidence of a well-developed rosette, there are dead leaves near the base of the stem in all our collections and these might easily be from the previous year's growth. We would consider it to be either a winter annual or a biennial.

There is a great deal of variation of height in this species as represented by our collections. Brand (*loc. cit.*) indicates a maximum height of 50 cm. for this species, although our specimens BAA 296 and BsH 323 exceed this by another 10 cm., while BBsH 118 attains a height of 70 cm. On the other hand our smallest flowering plant is but 7.5 cm. high. The sepal length given by Brand (*loc. cit.*) is 5 mm. in flower, and infrequently up to 10 mm. In our material this is about 3.5 mm. long in flower and about 7.5 mm. in fruit. Similarly Brand gives corolla length as 9 mm. while ours range from 7–8 mm. It is, however, possible that Brand first boiled his specimens, while our measurements are for the dry flowers. R. Brown's lucid description fits our material better than Brand's less complete and less accurate description but Brown gives plant height as only 6–10 inches; this is understandable since he based his description on material from farther north.

BORAGINACEAE

Echium vulgare L. Grand Marais, H. W. Slack (July 1892).—Introduced.

Cynoglossum boreale Fernald, Rhodora **7:** 249. *cf.* Johnston, Contr. Gray Herb. n. s. LXX: 34. Watab Lake, BA 115, BBsH 22; West Bearskin Lake, D 135.—Clearings and openings in forest; infrequent.

Mertensia paniculata (Ait.) G. Don *cf.* Fernald, Rhodora **37:** 328. Sawbill Lake, Bg 51; Poplar Lake, D 8; Brule River, E. Loula 17; Mountain Lake, BAA 239, BBsH 19, BBsH 82; South Fowl Lake, BABs 628; Royal River, BsH 291, BsH 362; Pigeon Point, BBs 716; Grand Portage, Be 479, S. Brown 9, BA 210; Hovland, Be 663; Grand Marais, N. L. Huff (July 10, 1925).—Moist woods, cliffs, ditches and portage trails; common.

All plants have some pubescence on the upper surface of the leaf, although some may have it nearly wanting. Thus none of this material is var. *subcordata* (Greene) McBr. to which Fernald refers (*loc. cit.* p. 328). There seems no reason to call our material anything other than typical as Williams (Ann. Mo. Bot. Gard. 24) treats the species.

Lappula echinata Gilib. Grand Marais, M. E. Oldenburg (Nov. 1944).—Introduced.

Hackelia americana (Gray) Fernald, Rhodora **40:** 341. *H. deflexa* (Willd.) Opiz, var. *americana* (Gray) Fernald & Johnston, Rhodora **26:** 124. Clearwater Lake, BA 125; Mountain Lake, BAA 276a, BBsH 43;

East Pike Lake, BsH 232; Royal River, BsH 340.—Cliffs and fine, gravelly talus; very abundant and generally diffused throughout the state.

LABIATAE

Scutellaria lateriflora L. Lake Saganaga, L. S. Cheney (July 25, 1891); Sawbill Lake, Bg 46; West Pike Lake, BsH 186; Susie Island, OO 1038; Lucille Island, OO 1093; Hovland, Be 659; Kimball Creek, R 2609; Temperance River, L 4712.—Stream, rivers, lakes, bottoms or banks.

S. epilobiifolia Hamilton. *cf.* Fernald, Rhodora **23:** 85; Leonard, Contr. U. S. Nat. Herb. 22: 723. *S. galericulata* of Am. auth. *not* L. Lake Saganaga, L. S. Cheney (July 23, 1891); Alton Lake, Bg 47; Birch Lake, BA 810; Gunflint Lake, BBl 383; Watab Lake, BAA 326; Clearwater Lake, N 1687; Royal River, BsH 287; Belle Rose Island, OO 1072.—Dams, lake margins, mucky swales.

Agastache Foeniculum (Pursh) Ktze. Tofte, L 4706.—Roadside.

Dracocephalum parviflorum Nutt. Watab Lake, BAA 223; Mountain Lake, BAA 267; East Pike Lake, BsH 215; South Fowl Lake, BsH 312, BM 10836; Mount Rose, SS 6067; Mount Josephine, BA 161.—Ridges, cliffs, hill-sides, talus slopes. Some individuals have pink flowers, some have blue.

Prunella vulgaris L., var. lanceolata (Barton) Fernald, Rhodora **15:** 183. Sawbill Lake, Bg 50; John Lake, BsH 286; Grand Portage, Be 534, R 6001, BAA 460; Tofte, R 7847.—Shady woods, old trails, camp sites, moist glades. Except for Be 534 and R 6001, these collections fall in f. *iodocalyx* Fernald.

Physostegia virginiana (L.) Benth., var. speciosa (Sweet) Gray. *P. speciosa* (Sweet) Sweet. Pigeon River, B (Sep. 3, 1927).—River mouth.

Galeopsis Tetrahit L. Susie Island, OO 1035, OO 1141; Grand Portage, Be 496, Be 571, S. Brown (1938); Grand Marais, T. S. Roberts (July 31, 1879), H. W. Slack (July 1892), R 2635, BR 6905, M. E. Oldenburg (Nov. 1944).—Shores and beaches, disturbed soil near habitations.

Stachys palustris L., *sens. lat.* Grand Portage, S. Brown (1935); Lutsen, BR 6525; Schroeder, OS 992.—Moist ground, ditches.

Blephilia hirsuta (Pursh) Benth. Grand Marais, H. W. Slack (July 1892).

Satureja vulgaris (L.) Fritsch. Lake Saganaga, L. S. Cheney (Jul. 25, 1891).—Portage trail.

Lycopus uniflorus Michx. Sawbill Creek, Bg 48; Caribou Lake, BsH 397; Canoe Lake, BsH 390; Susie Island, OO 1032b; Long Island, AA 503; Grand Marais, T. S. Roberts (Aug. 12, 1879); Temperance River, L 4714; Schroeder, O 986.—Moist soil near streams and pools and along portage trails.

L. americanus Muhl. Royal Lake, BsH 262; Susie Island, OO 1032a; Lutsen, R 7855.—Shady forest margins, ditches.

Mentha arvensis L., var. villosa (Benth.) S. R. Stewart. *M. canadensis* L. Sawbill Creek, Bg 49; Hungry Jack Lake, BAA 339; Royal Lake, BsH 257; Susie Island, OO 1125; Grand Portage, Be 655;

Grand Marais, T. S. Roberts (July 30, 1879); Schroeder, OO 995.—Moist places in swamps, ditches and near lake shores.

SOLANACEAE

Chamaesaracha grandiflora (Hook.) Fern. *Physalis grandiflora* Hook. Poplar Lake, BAA 325; MacFarland Lake, BBl 338.—Trails and roadsides; infrequent. This has every appearance of being an introduced weed, yet gives every evidence of being native.

SCROPHULARIACEAE

Linaria vulgaris Hill. Elbow Lake, E. Loula 8.—Roadside.

Scrophularia lanceolata Pursh. *S. leporella* Bickn. South Fowl Lake, BsH 301; Susie Island, R 6044; Mineral Center, BR 4569.—Exposed rocks.

Chelone glabra L. *sens. lat.* Pigeon River, B (Sep. 1, 1927); Hovland, Be 661; Kimball Creek, R 2606; Temperance River, OS 1002.—Old river beds, moist meadows; infrequent.

Mimulus ringens L. Sawbill Creek, Bg 45; Royal Lake, BsH 251; Pigeon River, BR 6269; Mark Creek, C. B. Reif A21.—Muddy areas or even submerged (in water 6″ deep); locally abundant.

Gratiola neglecta Torr. Grand Portage, BR 6275.—In clay holes in trail; occasional.

Veronica tenella All. *V. humifusa* Dickson. Mountain Lake, BAA 329; Grand Portage, BAA 452; Mount Josephine, BA 178.—Moist areas in and near portage trails, etc.; infrequent.

V. scutellata L. Mountain Lake, BAA 322; Pigeon River, BR 6273.—Moist places. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) from the tributaries of the Pigeon River. They state (*op. cit.*, p. 139) that this is the only occurrence of the species in the streams of the Minnesota North Shore of Lake Superior.

V. scutellata, var. villosa Schumacher. *cf.* Fernald, Rhodora **37:** 331. Clearwater Lake, BsH 163.—Low, wet ground near portage trail.

V. americana (Raf.) Schwein. Grand Portage, Be 536, Be 695, S. Brown (1935), BAA 453, BM 10867; Mount Josephine, BA 177; Mineral Center, BR 4581.—Ditches, old portage trails, in small streams; occasional.

V. peregrina L., var. xalapensis (HBK.) St. John & Warren. Lucille Island, OO 1107.—At edges of polluted pools, gull roosts, crest of island.

Castilleja septentrionalis Lindl. Grand Portage, L. S. Cheney (Jul. 6, 1891).— Very rare in Cook County; we have not observed it there, although the junior author found it locally abundant further east in the Thunder Bay Dist., Ont.

Melampyrum lineare Desr., var. lineare (Desr.) Beauv. *cf.* Fernald, Rhodora **44:** 446. Clearwater Lake, BBsH 166; Little Caribou Lake, BsH 395; Mountain Lake, BAA 294; Morrison Bay, BBs 727; Little Brick Island, OO 1080; Susie Island, BBl 353, AA 558; Grand Portage, L. S. Cheney (Jul. 6, 1891), Be 585, Be 678, R 7868.—Dry rocks, old portage trails, tops of cliffs; occasional.

M. lineare, var. americanum (Michx.) Beauv. Mountain Lake, BBsH 140; Morrison Bay, Rydberg & Rosendahl (Aug. 16, 1929); Mount Josephine, BA 170.—Exposed rocks; infrequent.

Euphrasia hudsoniana Fern. & Wieg., Rhodora **17:** 194. Pigeon Point, BAA 445; Clark's Bay, BR 6280; Morrison Bay, BBl 360; Brick Island, OO 1077; Susie Island, OO 1048; Long Island, AA 509; Grand Marais, T. S. Roberts (Aug. 1879), Cheney (June 27, 1891), H. L. Lyon 925, N. L. Huff (Jul. 9, 1925), R 5963 a & b, BR 6906; Cascade, Bg (Aug. 30, 1946); Lutsen, L 4783; Tofte, L 4777; Temperance River, L 4792, L 6757.—Rocks and ledges along the shore of Lake Superior; local.

Fernald in Gray's Manual, ed. 8, recognizes the presence of two species of *Euphrasia* in Minnesota, *E. arctica* Lange ("n. Minn.") and *E. hudsoniana* Fern. & Wieg ("n. e. Minn."). The recognition of the presence of the latter in our area is presumably based on some of our specimens which the junior author showed Prof. Fernald some ten years ago. We had carefully reworked the Lake Superior material and had decided it all belonged in *E. hudsoniana* rather than in *E. arctica* where it had earlier been put, for instance, in Gray's Man., ed. 7, by Pennell (Acad. Nat. Sci. Phila., Monogr. **1:** 487–9), and by Fernald and Wiegand (Rhodora **17:** 193). Therefore it is a little puzzling to find *E. arctica* still credited in ed. 8 of Gray's Manual to "n. Minn.," although it is gratifying to find *E. hudsoniana* accepted for "n. e. Minn."

A thorough examination of our material cited above, as well as of material from Isle Royale, material from elsewhere on the North Shore, and of specimens kindly loaned to us by the Gray Herbarium, has convinced us that our Great Lakes material in general is referable to *E. hudsoniana.* This conclusion has been fortified by comparisons with the numerous specimens of *E. hudsoniana* which the junior author collected on the University of Minnesota Expedition to Hudson Bay in 1939.

The Lake Superior material of *E. hudsoniana* differs from *E. arctica* in its small flowers and seeds, its tendency toward more sharply pointed and more or less spinulose calyx lobes and teeth of the leaves; its habit of branching is fastigiate rather than spreading; its corolla differs in the notching of the lobes of the lower lip, in the shape of the galea, and in its size; the bracts are rhombic and the leaves are oblong. (Incidentally the illustration of "*E. arctica*" in Pennell's monograph is an excellent representation of Minnesota material of *E. hudsoniana* and may indeed have been based on it.)

Another species to which the Lake Superior *Euphrasia* might be ascribed is *E. subarctica* Raup, Rhodora **36:** 87, at least as far as the published description for this species goes; but omitted from the original description is the fact (evident from the type material loaned to us by the Gray Herbarium) that long, gland-tipped hairs are present; the Lake Superior plants are eglandular.[17] The Lake Superior material is further differ-

[17] The extent to which the presence of glandular hairs is to be considered a sufficiently important character upon which to base subdivisions of the genus is a moot question in the opinion of the writers. We have seen material of *E. arctica* from Greenland which is distinctly glandular, while material from the Torngat Mountains

entiated from *E. subarctica* by its aristate-tipped leaf teeth, somewhat larger flower size, and more sharply pointed calyx lobes.

While there are a few minor differences between the Lake Superior plants and the Hudson Bay material of *E. hudsoniana* they are so slight as to hardly justify considering the Lake Superior material as worthy of even formal distinction. We prefer to keep it in this rather weak species of the *E. arctica* complex, which includes a number of other named phases. We are inclined to think of this group of species as a series of plants with an essentially common genetical composition in which a few genes are varying more or less independently. Along with this, slight geographical segregation has served to preserve minor variants.

LENTIBULARIACEAE

Utricularia vulgaris L. *cf.* G. B. Rossbach, Rhodora **41:** 113. Kelso River, Bg 44; Caribou Lake, "L. W. K." 14; Brule River, C. B. Reif A24; Grand Portage, BA 981, SS (June 28, 1948); Bally Creek, C. B. Reif A36; Temperance River, C. B. Reif A16.—In streams 1–3 ft. deep with rock, muck or sand bottom and shallow pools in Thuja swamps. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 139) under the name *U. macrorhiza* Le Conte from the Cascade River and characterized by them (*op. cit.*, p. 139) as rare and occurring mostly in beaver ponds.

U. minor L. Otter Lake, BA 798b.—Pools about an inch deep in a floating bog.

U. intermedia Hayne. Sea Gull Lake, L 3681; Otter Lake, BA 798a; Grand Portage, BA 980, SS 12025, S A5301.—Border of beaver dam pond; shallow pools in *Thuja* swamp and floating bog; shallows of L. Superior in Grand Portage Bay. Reported by Smith and Moyle (*op. cit.*, p. 134) as in the Brule River, and characterized by them as about as abundant and in the same situations as *U. vulgaris*.

Pinguicula vulgaris L. Pigeon Point, BAA 444; Morrison Bay, BBs 721; Porcupine Island, BBs 747; Susie Island, R 6037; Lucille Island, N 1664, BAA 360; Long Island, BAA 469, AA 514; Grand Marais, T. S. Roberts (Aug. 14, 1879), L. S. Cheney (June 20, 1891); H. W. Slack (July 1892), BR 4644, N. L. Huff (July 9, 1925), BA 42, BM 10769; Tofte, L 4782; Temperance River, SS 6031.—Pools and moist pockets in rocks along shore of Lake Superior; infrequent. It is represented from Minnesota in the Herbarium of the University of Minnesota only from Two Harbors and Gooseberry Falls (both in Lake County). It is also known from Isle Royale and the Thunder Bay Dist., Ont.

PLANTAGINACEAE

Plantago major L. Pine Lake, BsH 412; Grand Portage, Be 645, R 7897.—Portage trails, roadsides, beaches; introduced.

P. major, var. Pilgeri Domin. *P. major*, var. *pachyphylla* Pilger; *P.*

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of northern Labrador may be only slightly glandular, and that from the Gulf of St. Lawrence is eglandular. This is one of the many points which must be settled by some monographer when this interesting genus is satisfactorily studied.

asiatica acc. to Rydberg; *P. major*, var. *asiatica* (L.) Dcne. of many Amer. authors *fide* Pilger, Pflznrch IV. 269. p. 53. 1937. Grand Portage, Be 502; "shore of Lake Superior between Grand Marais and Grand Portage," L. S. Cheney (Jul. 1, 1891), F. F. Wood (Jul. 1, 1891).—Lake shores and open places, probably native. Identity of some of above collections uncertain because of immaturity of capsules.

P. Purshii R. & S. Grand Marais, BA 762.—By roadside in gravel of raised beach; rare. The first record in the Herbarium of the University of Minnesota from Cook County although common to the south.

P. virginica L. Grand Marais, BA 765.—On small ledges of disintegrating black eruptive rock; uncommon. First record from Minnesota in University of Minnesota Herbarium and curiously far north of its general range.

RUBIACEAE

Galium triflorum Michx. Poplar Lake, L. W. Orr 3, L. W. Orr 25; Birch Lake, BA 811; Clearwater Lake, BBl 469, BBsH 11; Lima Mountain, BA 889; John Lake, BM 10814; Royal River, BsH 248, BsH 346; Grand Portage, Be 521, Be 543; Mount Josephine, BA 174; Mineral Center, Be 693; Kimball Creek, R 2614; Kimball Lake, E. Loula 12.—Shady woods, portage trails, moist cliffs; general.

G. trifidum L. Sawbill Lake, Bg 43; Partridge Lake, BA 786.—Moist woods (black ash grove).

G. tinctorium L. *cf.* Fernald, Rhodora **37:** 444. *G. trifidum* L., subsp. *tinctorium* (L.) Hara, Rhodora **41:** 388. Elbow Lake, BBsH 133; Susie Island, OO 1036, OO 1130.—Moist woods.

G. labradoricum Wiegand. Cross River, BR 6372.

G. asprellum Michx. Sawbill Lake, Bg 42; West Pike Lake, BsH 187; Grand Portage, Be 681; Grand Marais, BA 755.—Moist arbor-vitae woods, roadside ditches, and lake shore.

Mitchella repens L. Grand Portage, BR 6274.—Old trail; infrequent.

Houstonia longifolia Gaertn. Temperance River, SS 6025.—Crevices in diabase; only collection from the county. It occurs on acid rock outcrops and sandy soils throughout much of the state, and is apparently more common in Lake and St. Louis Counties than in Cook County.

CAPRIFOLIACEAE

Diervilla Lonicera Mill. Sawbill Lake, Bg 41; West Bearskin Lake, D 132; Clearwater Lake, BBl 402; Grand Portage, Be 493; Mount Rose, S. Brown 31; Kimball Creek, R 2629; Poplar River, T. S. Roberts (Aug. 6, 1879).—Exceedingly common throughout.

Lonicera villosa (Michx.) R. & S., var. Solonis (Eaton) Fernald, Rhodora **27:** 6. Porcupine Island, BR 6246, AA 572; Schroeder, NBr 3211.—Woods and shores; common.

L. canadensis Bartr. Sea Gull Lake, L 3695; Cross River, BA 898; Poplar Lake, D 35; Clearwater Lake, BBl 400, BA 68; Lima Mountain,

BA 867; John Lake, BM 10815; Kimball Creek, R 2626; Carribeau River, BR 4490.—Woods; common.

L. oblongifolia (Goldie) Hook. Sea Gull Lake, L 3695a.—Common in the northern part of the state.

L. canadensis × L. oblongifolia. Sea Gull Lake, L 3687.

Although *L. canadensis* was in fruit (L 3695) and *L. oblongifolia* was in late flower and early fruit (L 3695a) at the time that the above collection was made, it is not inconceivable that a late flower of *L. canadensis* might at some time have permitted crossing of the two. L 3687 is in immature fruit, the berries being but poorly filled out. Its slender pedicels are 2 to 2.5 cm. long and the berries definitely separate, in these respects approaching *L. canadensis*. The leaves are larger than those of either putative parent (hybrid vigor perhaps) with the slender petioles about 0.5 cm. long, the base and apex both acute, thus resembling *L. oblongifolia* in shape. The texture of the leaf most nearly approaches that in *L. canadensis*.

L. dioica L., var. glaucescens (Rydb.) Butters. *cf.* Clements, Rosendahl and Butters, Minnesota Trees and Shrubs, p. 289, 1912. Sea Gull Lake, L 3682; Lima Mountain, BA 868; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 684.—Common throughout the state, but not often observed by the writers in Cook Co. It seems to have the same tendency as do poison ivy, Virginia Creeper, and *Celastrus scandens*, in seeking out the warmer slopes.

L. hirsuta Eat. Gunflint Lake, L 3717; Clearwater Lake, BsH 158, BA 948; Little Caribou Lake, BsH 416; Mountain Lake, BAA 265; MacFarland Lake, BBl 329, BBl 335; Royal River, BsH 353; Devil's Track River, C. W. Hall (Aug. 21, 1879).—Cliffs and woods; rather common in northern Minnesota generally.

Symphoricarpos albus (L.) Blake. Sea Gull Lake, L 3688; Clearwater Lake, BBl 423; West Pike Lake, BsH 195; East Pike Lake, BsH 223; John Lake, BM 10812; Thunder Bay Dist., Ont. (North Fowl Lake) BABs 699, (Pigeon Bay) AA 606.—Frequent on cliffs and slopes. Our collections range from the glaucous extreme often referred to as var. *pauciflorus* (Robbins) Blake to the typical material with leaves green below.

Linnaea borealis L., var. americana (Forbes) Rehder. Sea Gull Lake, L 3616; Sawbill Lake, Bg 40; Poplar Lake, L. W. Orr 6, D 91; Moss Lake, D 141; Clearwater Lake, BBl 468; Susie Island, OO 1022; Grand Portage, Be 474, Be 489, R 5992, S. Brown 18; Brule River, BR 4519a; Carribeau River, BR 4518.—Very common in woods of the region.

Viburnum Rafinesquianum Schultes. *V. affine* Bush, var. *hypomalacum* Blake, Rhodora **20:** 14. Clearwater Lake, BBl 422; East Pike Lake, BsH 222; Royal River, BsH 352; Fort Charlotte, BR 6264; Mount Josephine, BA 1048; Thunder Bay Dist., Ont. (North Fowl Lake) BABs 679.—Woods; not overly common.

V. edule (Michx.) Raf. *cf.* Fernald, Rhodora **43:** 481. *V. pauciflorum* La Pyl. Clearwater Lake, BBl 403, BBsH 10, BA 946, D 123;

Little Caribou Lake, BsH 394; Mountain Lake, BAA 293; South Fowl Lake, BsH 313, BM 10824; Pigeon Point, BBs 737; Little Brick Island, OO 1078; Grand Portage, Be 554 and 632, R 5995, Butters & Wherry (June 30, 1935), R 7871; Brule River, BR 4532; Kimball Creek, R 2634; Grand Marais, L. S. Cheney (June 20, 1891); Carribeau River, BR 4488; Lutsen, L 4785.—Abundant in woods of Cook Co., but has not been collected elsewhere in Minnesota.

V. trilobum Marsh. *V. Opulus* L., var. *americanum* Ait. Royal River, BABs 712; Fort Charlotte, BR 6265.—Moist woods near streams; common in the state, but infrequent in Cook Co.

Sambucus pubens Michx. *cf.* Fernald, Rhodora **35:** 310. Poplar Lake, D 47; Grand Portage, BA 160; Grand Portage Island, R 6034a; Grand Marais, BR 4506.—Common.

CUCURBITACEAE

Echinocystis lobata (Michx.) T. & G. Lutsen, L 4787.—Shore of Lake Superior. Has ripe fruit and thus is apparently capable of reproducing itself but is nevertheless uncommon.

CAMPANULACEAE

Campanula rapunculoides L. "between Tofte and Grand Marais," J. B. Moyle 3441.—Introduced.

C. rotundifolia L. *cf.* Malte, Rhodora **36:** 188. Rove Lake, BBl 431; Clearwater Lake, BBl 462; Little Caribou Lake, BsH 396; John Lake, BM 10789; South Fowl Lake, BsH 325; Pigeon Point, BR 6254; Grand Portage, Be 643; Grand Portage Island, R 6025; Grand Marais, T. S. Roberts (July 31, 1879), R 5968; Tofte, L 4776.—Frequent on the inland cliffs, in river gorges, and on shore rocks of Lake Superior. We have listed above the plants which are of the "usual" height and which are more or less bristly puberulent. A dwarf phase of otherwise typical material occurs on the more exposed shore rocks of Lake Superior, represented by the following:—Pigeon Point, B (Sept. 3, 1927), BBs 740; Long Island, AA 527; Grand Marais, N. L. Huff (July 9, 1925); Thunder Bay Dist., Ont. (the Boundary Islands in Pigeon Bay), AA 594.

C. rotundifolia L., var. intercedens (Witasek) Farwell. Little Caribou Lake, BsH 411; Mountain Lake, BBsH 34; East Pike Lake, BsH 224; South Fowl Lake, BsH 317; Pigeon Point, BAA 433; Grand Portage, BAA 470; Temperance River, SS 6038; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 694.—Common on cliffs.

This is the extreme which is glabrous or merely pubescent in lines, at the other extreme are the plants which are bristly puberulent. In this character as well as in shape of ovary, length of calyx lobes, etc. there is much variation in our material, the characters varying independently as though in different genetical linkage groups. The recognition of var. *intercedens* is therefore merely one of convenience. That pubescence is probably connected with genetical causes is indicated by the observation in the field that some colonies are composed of pubescent individuals only while other colonies are much less so. Some of the plants listed are the

familiar albescent phase which has the pale yellow green foliage and colorless corolla. This set of characters also varies independently of the ones previously mentioned.

C. ULIGINOSA Rydb. Sawbill Creek, Bg 39; Cross River, BA 899; Royal River, BsH 256, BsH 328; Grand Marais, T. S. Roberts (Aug. 12, 1879); Bally's Creek, C. B. Reif A34.—Swamps and marshes; infrequent.

LOBELIA KALMII L. *cf.* McVaugh, RHODORA **38:** 355. Grand Marais, T. S. Roberts (July 27, 1879), H. Lyon 927; Tofte, L 4774, R 7822.—Shore rocks of Lake Superior.

L. DORTMANNA L. *cf.* McVaugh, RHODORA **38:** 357. Sawbill Lake, Bg 38; Birch Lake, BA 813; Leo Lake, BAA 329a; Grand Marais, L. W. Krefting (July 1937).—Sandy bottoms of shallow lakes.

COMPOSITAE

EUPATORIUM MACULATUM L. Sawbill Lake, Bg 30; Hungry Jack Lake, BR 6335; Lima Mountain, BA 860; South Fowl Lake, BsH 326; Grand Portage, R 7903; Hovland, R 7874.—Lake shores, moist woods.

E. MACULATUM L., var. FOLIOSUM (Fern.) Wieg. RHODORA **22:** 66. Grand Portage, Be 524.—Trail.

E. PERFOLIATUM L. Sawbill Lake, Bg 27.—Portage.

SOLIDAGO HISPIDA Muhl. *ex* Willd., var. TYPICA Ros. & Cron. Hungry Jack Lake, BR 6362*, BsH 419*; Clearwater Lake, BBl 467*.—Cliffs and roadsides.

S. HISPIDA Muhl., var. ARNOGLOSSA Fern. Little Caribou Lake, BsH 404*; South Fowl Lake, BsH 281*, BsH 315*; Royal Lake, BsH 247*, BsH 359*; Porcupine Island, BR 6257*, OO 1012; Susie Island, B (Sep. 2, 1927)*; Long Island, AA 513*; Sailboat Island, AA 534*; Grand Portage Island, R 6031*; Cascade River, T. S. Roberts (Aug. 2, 1879)*.—Inland cliffs and shore rocks of Lake Superior.

S. ULIGINOSA Nutt. Cross River, BA 911†; Aspen Lake, BA 949; Lima Mountain, BA 852†; Clark's Bay, BR 6257*; Porcupine Island, OO 1013; Susie Island, AA 557*; Long Island, AA 519*; Grand Portage, Be 692*, B (Sep. 15, 1929)*; Grand Marais, R 5966*; Hovland, OO 1003.—Shore rocks and nearby wet meadows.

S. JUNCEA Ait. Grand Portage, Be 552, Be (Aug. 23, 1929), R 7865.—Old trails and woods margins.

S. NEMORALIS Ait. Grand Portage, R 7861, BA 1018†; Mount Josephine, BR 6311*, BR 6322*, BR 6323*, BA 1039†; Hovland, OO 1008; Thunder Bay Dist., Ont. (Pigeon Bay), AA 604*.—Dry rocks, roadside.

S. CANADENSIS L. Poplar Lake, BA 834†; Lima Mt., BA 851†, BA 859†; Greenwood Lake, BA 988†; Grand Portage, R 7870; Hovland, OO 1007; Poplar River, T. S. Roberts (July 1878); Tofte, R 7829.—Clearings and roadsides.

* *Solidago* spp. *fide* Arthur Cronquist. (*cf.* C. O. Rosendahl & Arthur Cronquist. The goldenrods of Minnesota. Amer. Midl. Nat. **33:** 244–253.) Absence of an asterisk or dagger indicates identification by the collector.

† *Solidago* spp. *fide* C. O. Rosendahl.

S. lepida DC., var. fallax Fernald, Rhodora **17:** 9. Grand Portage, Be 686*.—Lake shore.

S. gigantea Ait., var. leiophylla Fernald, Rhodora **41:** 457. Schroeder, N 1730*.

S. graminifolia (L.) Salisb. South Fowl Lake, BsH 293; Little Brick Island, OS 1081; Susie Island, R 6063, OO 1042; Sailboat Island, AA 537; Cascade River, T. S. Roberts (Aug. 3, 1879).—Shore rocks, rock crevices.

Aster macrophyllus L. Sea Gull Lake, BA 922; East Pike Lake, BsH 210*.—Dry soil on cliff top and in gravel pit.

A. macrophyllus L., var. velutinus Burgess. Hovland, Be 668*; Tofte, R 7838.—Roadside.

A. ciliolatus Lindl. *A. Lindleyanus* T. & G. Gunflint Lake, R 5453*; Poplar Lake, R 5437*; Pine Lake, BsH 375*; Pigeon River, R 6031*; Grand Portage, Be 631*, BA 991; Tofte, R 7839, R 7840, R 7844, R 7846, R 7851.—Woods, trails and roadsides.

A. puniceus L. Hungry Jack Lake, BsH 417*; Lima Mountain, BA 855; Royal Lake, BsH 347*; Pigeon River, AA 586*; Grand Portage, BA 964, BA 991, R 7895; Hovland, Be 666*.—Woods and roadsides.

A. lateriflorus (L.) Britt. Grand Portage, Be 664*; Hovland, Be (Aug. 23, 1929)*; Kimball Creek, R 2615; Tofte, L 4713*.—Woods and roadsides.

A. simplex Willd. Pigeon River, AA 587*; Grand Marais, BA 1020; Tofte, R 7854; Schroeder, BA 1068.—Woods and roadsides.

A. puniceus L. × A. simplex Willd. Pigeon River, AA 585*.—Woods. The two putative parents were collected the same day at the same locality (AA 586 and AA 587).

A. junciformis Rydb. Sea Gull Lake, BA 923; Grand Marais, H. L. Lyon 930*.—Gravel pits, etc.

A. longulus Sheldon. *A. junciformis* × *A. puniceus*, Shinners, Rhodora **44:** 338. Lutsen, R 7856; Tofte, R 7828, R 7832, R 7857.—Moist banks and clearings.

A. ptarmicoides (Nees) T. & G. Pigeon Point, BAA 426*; Grand Portage, N 1638*; Grand Marais, T. S. Roberts (Jul. 31 & Aug. 1879)*, H. W. Slack (Jul. 1892)*, H. L. Lyon 921*, R 5964*, BR (Aug. 14, 1934)*, BR 6910*; Cascade, Bg (Aug. 30, 1946); Tofte, L 4780*, R 7823; Temperance River, SS 6030.—Shore rocks.

A. pubentior Cronq. *A. umbellatus* Mill., var. *pubens* Gray. Lima Mountain, BA 850; Brick Island, OO 1075; Long Island, AA 524*; OO 1110; Kimball Creek, R 2613*; Grand Marais, BR (Aug. 14, 1934)*; Tofte, R 7824; Temperance River, L 6763; Schroeder, BA 1073.—Shore rocks, woods, roadsides.

Erigeron philadelphicus L. Grand Portage, S. Brown (1935)*, BA 204*; Devil's Track River, BR 4666*.—Trails and stream banks.

* *Aster* spp. *fide* Arthur Cronquist. (*cf.* C. O. Rosendahl & Arthur Cronquist. The Asters of Minnesota: A floristic study. Amer. Midl. Nat. **42:** 502–512.) Absence of an asterisk signifies identification by the collector.

E. STRIGOSUS Muhl. Pine Lake, BsH 388*; Grand Portage, BA 1017, BA 1030.—Trail, dry open woods, woods roads.

E. STRIGOSUS Muhl., var. SEPTENTRIONALIS (Fern. & Wieg.) Fern. Mountain Lake, BAA 266*; Grand Marais, BA 766; Thunder Bay Dist., Ont. (South Fowl Lake), L. S. Cheney (Jul. 9, 1891)*.—Portage trails and dry rocky cliff top.

E. ANGULOSUS Gaud., var. KAMTSCHATICUS (DC.) Hara *E. elongatus* Ledeb. Susie Island, R 6058; Pigeon Point, BA 994.—Talus and rocks by lake shore; only collections known from state.

E. COULTERI Port. Grand Portage, B (no no., no date)*.—Abandoned garden; introduced, not naturalized.

E. CANADENSIS L. *Conyza canadensis* (L.) Cronquist. Poplar Lake, BA 841; Clearwater Lake, BA 951; Rocky Lake, BsH 377*; MacFarland Lake, BsH 371*; South Fowl Lake, BsH 321*; Royal Lake, BsH 245†; Grand Marais, T. S. Roberts (Aug. 12, 1879)*.—Open woods on crests of cliffs, burnt over slopes, dry talus.

ANTENNARIA CANADENSIS Greene. Clearwater Lake, BA 69; Mountain Lake, BBsH 63; Grand Portage, BA 145.—Dry soils of open woods, pine forests on shoulders of cliffs and hillsides.

A. NEODIOICA Greene. Rove Lake, BBl 436; Watab Lake, BAA 233; Mountain Lake, BBsH 39; Thunder Bay Dist., Ont. (North Fowl Lake), BABs 680.—Tops of cliffs in open woods, and on cliffs.

A. NEODIOICA, var. ATTENUATA Fernald. Poplar Lake, D 40, D 50; Watab Lake, BA 107; John Lake, BM 10811.—Dry hilltops and slopes, roadsides.

A. PETALOIDEA Fernald. Carlton Peak, MacMillan (July 1900).—Infrequent in Minnesota.

A. MUNDA Fernald, RHODORA **38:** 229. Poplar Lake, D 62; Little Caribou Lake, BsH 409; Clearwater Lake, D 112; Mountain Lake, BBsH 38; Royal River, BsH 337; Mount Josephine, BA 176.—Open places on slopes, cliffs and cliff-tops. BsH 337 is placed here provisionally, the veins of the leaves not being as hairy as in the rest of our *A. munda*.

ANAPHALIS MARGARITACEA (L.) C. B. Clarke, var. INTERCEDENS Hara. *cf.* Hara, RHODORA **41:** 391. Sawbill Lake, Bg 2, Bg 28; Clearwater Lake, BBl 451; Northern Light Lake, E. Loula 11; Susie Island, OO 1126; Grand Portage, Be 682.—Roadsides and other openings; common.

GNAPHALIUM MACOUNII Greene. Greenwood Lake, BA 986.—Old gravel pit.

AMBROSIA TRIFIDA L. Grand Portage, BR 6213.—Disturbed soil near habitations.

A. PSILOSTACHYA DC., var. CORONOPIFOLIA (T. & G.) Farw. Grand Marais, Dr. Stenstrom (Aug. 1933).—Roadside.

* *Erigeron* spp. *fide* Arthur Cronquist. (*cf.* Arthur Cronquist. Revision of the North American species of Erigeron, north of Mexico. Brittonia 6: 121–300.) Absence of an asterisk signifies identification by the collector.

† *Conyza canadensis fide* Arthur Cronquist. (*cf.* Bull. Torrey Bot. Cl. **70**: 629–632.)

Rudbeckia hirta L. Sawbill Lake, Bg 14; Royal Lake, BsH 270; Tofte, L 4705; Grand Portage, BA 1016; Mineral Center, BA 1089.—Clearings and roadsides.

Helianthus borealis E. E. Watson, Papers Mich. Acad. Sci., Arts and Letters **9:** 411. (1929). John Lake, BsH 285; Mineral Center, BA 1090.—Rocky fields.

H. laetiflorus Pers., var. rigidus (Cass.) Fern. Grand Portage, BA 1026.—Meadow.

H. maximiliani Schrad. Mineral Center, BA 1087, BA 1088; Grand Portage, BA 1027.—Roadsides. BA 1087 is a depauperate, monocephalic form growing with normal plants (BA 1088).

Bidens cernua L. Hungry Jack Lake, BR 6358; Pigeon River, BR 6271.—Locally abundant on flats at river mouth and along wet pond shore.

B. vulgata Greene, f. puberula (Wieg.) Fernald. Greenwood Lake, BA 987.—Gravel pit.

Megalodonta Beckii (Torr.) Greene. *Bidens Beckii* Torr. Birch Lake, BA 806. Reported by Smith and Moyle (Minn. Dept. Cons., Tech. Bull. 1, p. 134) from the Cross and Brule Rivers, and characterized by them (*op. cit.*, p. 139) as "Rare; in quiet waters."

Achillea Ptarmica L. Susie Island, OO 1144 (det. C. O. R.).—"Common near cabin." Introduced.

A. Millefolium L. Rove Lake, BBl 430.—Aspen woods.

This collection is placed here provisionally, but is not in good flower.

A. lanulosa Nutt. Sawbill Lake, Bg 21; Brule River, E. Loula 10; Watab Lake, BA 104, BAA 320; Royal Lake, BsH 265, BsH 348; Pigeon Point, BAA 446; Clark's Bay, BAA 395a; Porcupine Island, AA 570; Susie Island, OO 1137, OO 1154; Lucille Island, BAA 362; Long Island, AA 518, AA 548; Sailboat Island, AA 541; Grand Portage, Be 566, S. Brown (1935); Grand Marais, ?T. S. Roberts (Jul. 27 & 31, 1879), R 5973, M. E. Oldenburg (Nov. 1944); Poplar River, T. S. Roberts (1878); Thunder Bay Dist., Ont. (Pigeon Bay), AA 593.—Dry ledges, rocky and gravelly shores. The familiar pink-rayed variant is represented in several of these collections.

This puzzling genus has been surveyed on the basis of the Minnesota material for differences between *A. lanulosa* and *A. Millefolium.* Within the group of plants cited above as *A. lanulosa* the rays vary from 1.5 to 3 mm. in length, the involucral bracts from pale straw color to nearly chestnut, the vestiture of the plant as a whole from slightly to heavily lanate. Constant however are the ascending leaves and leaf segments, which give the living plants a plumose appearance and cause many herbarium specimens to have such poorly displayed leaves. Also the leaves (as compared with those of *A. Millefolium*) are short, narrow, and broadest toward the base. The midrib of the leaves tends to remain but very narrowly winged as contrasted with the broader wing found along the midrib in *A. Millefolium.* The plant as a whole tends to be somewhat more strict and the inflorescence branches relatively short, although this

is not invariably the case. Often the inflorescences are convex, but may occasionally be flat-topped.

The distinction between *A. lanulosa* and *A. occidentalis* as indicated by Rydberg (N. Am. Flora, vol. 34, 224) is not clear to us.

Matricaria maritima L., var. agrestis (Knaf) Wilmott. *M. inodora* L. Grand Marais, BR (Aug. 14, 1934), BR 6904, M. E. Oldenburg (Nov. 1944).—Shingle beach and roadsides throughout the village as well as on the Point.

M. matricarioides (Less.) Porter. *M. suaveolens* (Pursh) Buch. Sawbill Lake, Bg 16; MacFarland Lake, BM 10863; Susie Island, OO 1140; Grand Portage, S. Brown (1935).—Weed.

Chrysanthemum Leucanthemum L., var. pinnatifidum Lecoq & Lamotte. *cf.* Fernald, Rhodora **5:** 177. Sawbill Lake, Bg 19; West Bearskin Lake, D 146; South Fowl Lake, BsH 294; Grand Portage, Be 569.—Rubble beaches and disturbed land near habitations; introduced weed. It occurs in vast quantities on the east (Canadian) side of the Pigeon River, just below the outlet of South Fowl Lake, at the site of an old lumber camp.

Artemisia caudata Michx. South Fowl Lake, BsH 284, BsH 309; Royal River, BsH 333.—Cliffs, dry exposed areas; rather infrequent, being more general in the southern two-thirds of the state in wooded and prairie habitats. All this material has very narrow leaves and no sign of perennation. BsH 333 is a little more pubescent than usual and therefore is equivalent to var. *calvens* Lunell.

A. canadensis Michx. *sens. lat.* Mount Josephine, BR 6317, BA 166a, BA 1033; Thunder Bay Dist., Ont. (Pigeon Bay), AA 597.—Dry cliffs and on hilltops.

Our material is definitely perennial and rather small-headed (although not as small-headed as *A. caudata*) and corresponds to the description given for *A. camporum* Rydb. by Rydberg (N. A. Flora, vol. 34, pt. 3: 254) as well as to specimens so named by him. The treatments of this group in North America have been so diverse that we hesitate to confuse the nomenclature further by proposing a new varietal combination without a thorough study of forms throughout the continent. Our Minnesota material appears to conform to a fairly definite type which has the characters attributed to *A. camporum* Rydb. The matter is further involved because there is some question of whether *A. camporum* and *A. pacifica* Nutt. are conspecific. Also there is some doubt as to the proper application of *A. canadensis;* it is variously interpreted by A. Gray (Synopt. Fl. N. A., ed. 2, p. 368), by Fernald (Mem. Gray Herb. II, p. 284), by Hall and Clements (Carnegie Inst. Wash. Publ. 326, p. 124), and by Rydberg (*op. cit.* p. 255).

Petasites palmatus (Ait.) Gray. Rove Lake, BA 106a; Mountain Lake, BBsH 60; Royal River, BsH 345; Pigeon River, BR 4618.—Moist woods and ravines.

P. sagittatus (Pursh) Gray. Watab Lake, BBsH 116 (leaves only).—Lowland woods; rather rare in the state.

Arnica chionopappa Fernald, Rhodora **7:** 148; *idem* **26:** 105; *idem* **35:** 366–367. Clearwater Lake, BBl 404, BA 93, BBsH 8.—Locally abundant on a north-facing cliff of calcareous slate on south side of the lake, the only station known in Cook County.

M. L. Fernald has discussed the present find in Rhodora **35:** 367 and there gives a map showing this station in relation to the then-known distribution of this species. Other stations for this conspicuous species (the bright yellow of the above colony is clearly visible across the width of Clearwater Lake when the plants are in flower) have been sought during a series of summers in the intensive collecting which has been prosecuted in Cook County. Yet it has not been found elsewhere in the county. This poses a problem in dissemination:—with a pappus so well-adapted to wide distribution, why should it be so extremely local in occurrence?

An *Arnica*, apparently this same species, has been collected by Miss Lakela in Lake County. It seems to have a series of minor differences which distinguish it from the Clearwater Lake material.

Senecio pauperculus Michx. Tofte, L 4837.—Shore rocks.

S. pauperculus Michx., var. Balsamitae (Muhl.) Fern. Grand Marais, BR 4665—Along a stream.

S. pauperculus, var. Balsamitae, f. inchoatus Fernald, Rhodora **30:** 226. John Lake, BM 10808; Pigeon River, BR 6267; Grand Marais, MacMillan & Hibbard (July 1900).—Cliffs, etc.

S. aureus L. Susie Island, OO 1030; Lucille Island, OO 1091.—Edge of woods.

S. eremophilus Richardson. *cf.* Greenman, Ann. Mo. Bot. Gard. **2:** 597–598. Thunder Bay Dist., Ont. (Pigeon Bay), AA 605.—Dry, slate cliffs. Certainly to be expected in Minnesota, the above station being on the north side of a narrow bay through which the Internatioanl Boundary runs. It has been reported heretofore only as far east as the Dakotas and Manitoba.

This material is a good match for Greenman's description of this species. There is a great deal of variation in the leaves which in some plants are rather deeply pinnatifid while in others they are merely strongly dentate. The latter type of plant doubtless is Rydberg's *S. Kingii* which Greenman reduced to a variety. In our opinion it is hardly worthy of taxonomic rank, since both types of leaf may be found on the same plant.

Arctium minus (Hill) Bernh. Cascade River, BA 759.—Roadside.

Cirsium vulgare (Savi) Tenore. *C. lanceolatum* Scop. Sawbill Lake, Bg 32; Lima Mountain, BA 648.—Roadsides.

C. undulatum (Nutt.) Spreng. Grand Marais, T. S. Roberts (Aug. 14, 1879).—"A few plants growing in a pasture field (Howenstein's) and said to have appeared recently" according to the label on the above collection. Not noted since.

C. muticum Michx. Sawbill Lake, Bg 33; Lima Mountain, BA 849.—Roadsides.

C. arvense (L.) Scop. Sawbill Lake, Bg 37; Mineral Center, Be 688.—Woods and roadsides; common along highway west of Grand Marais.

TARAXACUM PALUSTRE (Lyons) Lam. & DC., var. VULGARE (Lam.) Fernald, RHODORA **35:** 380–383. Lucille Island, BAA 370; Grand Marais, BA 34.

The Grand Marais collection we at first thought represented a distinct form because of the abundant kinky, flattened, multicellular hairs which form a lanate pubescence along the midrib, while similar but shorter hairs occurred elsewhere on the leaves. Careful field observations made upon a second visit to the locality in 1937 convinced us that it is merely a teratological response which is not constant; some plants have both very pubescent and practically glabrous leaves, while there are other individuals at this same station which are uniformly glabrous-leaved.—A reminder to unwary botanists of the pitfalls afforded by dandelions!

SONCHUS ARVENSIS L. Grand Marais, BA 758.—Roadside.

LACTUCA LUDOVICIANA (Nutt.) Riddell. Cross River, BA 929; Birch Lake, BA 826.—Cut-banks and trails.

L. BIENNIS (Moench) Fernald. Lima Mountain, BA 858; Grand Portage, BA 1019.—Trails.

PRENANTHES ALBA L. Pigeon Point, BAA 413, BAA 421; Porcupine Island, BR 6247; Long Island, AA 521; Grand Portage, Be 507; Tofte, L 4778.—Cliffs, trails, shore rocks.

HIERACIUM AURANTIACUM L. Poplar Lake, Bg (photographic record, July 1943).—Roadside. The red phase. Associated with *Ranunculus acris* and *Chrysanthemum Leucanthemum.*

H. CANADENSE Michx. Sawbill Lake, Bg 15; Birch Lake, BA 825; John Lake, BsH 246; Grand Portage, Be 652; Tofte, R 7843.—Trails, roadsides, and near human habitations.

H. UMBELLATUM L. *H. scabriusculum* Schwein. West Pike Lake, BsH 193; Pine Lake, BsH 376a, BsH 414; Clark's Bay, R 6082.—Trails and cliff-tops.

H. SCABRUM Michx. *cf.* Fernald, RHODORA **16:** 181. Alton Lake, Bg 17; Pine Lake, BsH 376, BsH 413.—Portage trails in dry open birch woods, etc.—DEPARTMENT OF BOTANY, UNIVERSITY OF MINNESOTA, MINNEAPOLIS 14, MINNESOTA.

THE IDENTITY OF HEDYOTIS ROSEA RAF.—In the spring of 1950 and 1952 the author found growing on prairies near Stillwater, in rather localized patches, a species of *Hedyotis* (*Houstonia*) characterized by having large pink corollas (ca. 1 mm. in diameter) which are hairy in the throat, flat fruits, and spatulate basal leaves as Mueller and Mueller described *Houstonia pygmaea.*

A study of our material shows three additional characteristics that may be used for differentiating this species from our much

[1] Mueller, C. H. and Mary T. Mueller, *A New Houstonia in South-central Texas.* Bull. Torr. Bot. Cl. 63: 33–34, 1936.

more common one usually referred to *H. minima.* The shape of the seeds are oblong to oblong-ovate in outline. They have a similarly shaped cavity where the seeds surround the placental attachment, this cavity being ridged, or keeled, longitudinally within (as mentioned by Gray in Syn. Fl. 1 (2): 25. 1886). The seeds are about 1 mm. long and 0.5 mm. wide; the opening is about 0.6–0.7 mm. long and 0.2–0.3 mm. wide. In *H. minima* both the seeds and the hilar cavity are circular in outline, the seeds being ca. 1.0 mm. wide, with a cavity ca. 0.3–0.4 mm. wide. The upper surface of the corolla lobes of the former species are densely clothed by minute short, flat, broad-based enations easily seen with a magnification of 30X. These are not found in *H. minima.* The stipules of *H. minima* have a triangular to lanceolate free portion about 1 mm. long, while the pink-flowered species has the joined stipules almost truncate, to rounded, to very short- and broadly-triangular at the summit.

An examination of material borrowed from the Gray Herbarium shows the pink-flowered taxon to be the same as the one Gray described as *Houstonia patens* Ell., var. *pusilla* (l. c.). It also seems the same as *Houstonia pygmaea* Mueller and Mueller, although the author has been unable to locate any type material of that species upon which the name *Hedyotis Taylorae* Fosberg, Field and Laboratory **17:** 169. 1949, is based.

In *Florula Ludoviciana:* 77, 1817, Rafinesque describes two species of *Hedyotis* as follows:

> 243. *Hedyotis crassifolia* Raf. Ramis tenuis divaricatis sulcatis unifloris, foliis sessilibus oblongis acutis glabris integris carnosis, floribus longe pedunculatis. Raf.—Anonyme 1. Rob. p. 454. This plant, although resembling very much the *Houstonia*, is a real Hedyotis having a capsul two celled and polysperme. It blossoms in February, it varies with white, deep violet, and pale violet flowers, stem only two inches high, tube of the corolla filiform, four stamina in the tube nearly sessile, style short, stigma oblong, capsul heart-shaped with many minute seeds.
>
> 244. *Hedyotis? rosea* Raf. Repens, floribus roseis.—Anonyme 2. Rob. p. 454. This may be the *Houstonia tenella* of Lyon and Pursh; Robin does not describe it, but he merely says it is still smaller than the foregoing, creeping, and with flowers of a pale rose colour.

The first species is believed by Shinners[2] to be the common

[2] Shinners, Lloyd. *Transfer of Texas Species of Houstonia to Hedyotis.* Field and Laboratory. 17: 166–169. 1949.

bluet, possibly *H. pusilla* Schoepf. 1788, non Hochst. ex. A. Rich. 1847; *H. patens* Ell., 1817, non *Hedyotis patens* Ridley, 1908.

One might question whether such an abbreviated description as Rafinesque gives for the second species can be applied with certainty to *any* species, and if not, therefore, it would be better to reject it as a *nomen dubium* in accordance with Article 63 of the International Rules. The species is not repent with us (it appears so in some well developed specimens), but the rose color of the flowers is very striking and distinctive. When in flower it may be recognized upon sight by this one characteristic. I have not seen a pink-flowered individual that has not proven to be *H. rosea.* It is almost impossible to find the species after the flowers have fallen unless their location is ascertained while they are in flower.

While we may deplore the fact that the description of Rafinesque does not contain more data (in this case it couldn't, since it was merely a translation and a formal naming of a plant described and listed as *Anonyme 2* by Robin), he *did* furnish it with a description that seems to characterize it. Can it, then, be rejected as a *nomen dubium?*

H. rosea has not been previously recorded in the Oklahoma flora. The following sheets are representative: *Trelease*, Poteau, Indian Territory (Oklahoma), Feb. 21, 1901; *Waterfall 9265*, prairie 6 miles north of Stillwater, Payne Co., March 24, 1950; *Waterfall 9267*, around buffalo-wallow in prairie, 5 miles south of Stillwater, Payne Co., March 30, 1950.

The author is indebted to the curators and the librarians of the Gray Herbarium and the Missouri Botanical Garden for the loan of specimens and the copying of descriptions.—U. T. Waterfall, Department of Botany, Oklahoma A. &. M. College, Stillwater, Oklahoma.

Angiosperm Pollen.[1]—Recent trends in taxonomy have included the utilization of more diversified data than formerly. Plant anatomy, cytology, genetics and physiology have become increasingly important areas of investigation for taxonomic purposes. These new approaches have inevitably focused attention upon minute structures of plants

[1] Pollen Morphology and Plant Taxonomy. By G. Erdtman. XII + 537 pages and 261 illustrations. The Chronica Botanica Company, Waltham, Mass. 1952. $14.00.

which are now known to be as useful as many other plant features in indicating relationships and helping with the unraveling of complex taxonomic questions. Pollen has proved to be particularly useful in this connection. Pollen grains are definitive microscopic structures formed in the relatively uniform environment of the enclosed anther. This minimizes the range of variation due to extrinsic environmental factors. Thus, for example, size relationships as well as the more commonly used morphological features are often valuable in phylogenetic studies. The fact that pollen is most commonly shed from the parent plant permits it to be preserved in many instances where the plants themselves have become extinct without leaving any other trace.

The extended studies of pollen, both recent and fossil, have brought to light marked divergencies in pollen form, but these have not always been fully appreciated. The great differences are elegantly brought out in the numerous fine illustrations of the book under review which alone will go far toward elliciting an appreciation of the many remarkable forms and surface features of Angiosperm pollen.

Previous books devoted either wholly or in part to pollen have made no attempt to cover the Angiosperms as a whole. One of the very useful features of Erdtman's book is this coverage. Here one may turn to the material pertinent to a given family of plants and obtain a knowledge of the type or types of pollen found in it. Again, the illustrations are helpful in portraying shapes and obscure features that will assure an accurate interpretation by the reader.

This is definitely a reference book. It is not a textbook. The material in it is organized in a systematic way under the families, which are in alphabetical order. The text is primarily descriptive with only occasional attempts at interpretation and evaluation. Although the title would suggest some kind of application of pollen morphology to taxonomy, this has been done only in a few scattered instances. The rôle of certain types of pollen in phylogeny might have become evident had the families been arranged according to a well known system of classification. However, it is realized that for some purposes an alphabetical arrangement of the families makes the information under each more readily available to a wider audience of readers.

There is introduced a very large and complex terminology concerning the structure and form of pollen that to me seems not wholly justified. At least, I feel sure the ease with which the book may be used by botanists not specializing in pollen studies is considerably reduced thereby. However, on the whole, the book is very well done and will be found useful as a reference in a wide variety of botanical studies. While the price is perhaps understandable, in view of the numerous illustrations, I believe the amount is too great to permit the average botanist, in the United States at least, to own a copy.—R. C. Rollins.

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Rhodora

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Rhododendron × gladwynensis.

Rhodora

JOURNAL OF

THE NEW ENGLAND BOTANICAL CLUB

Vol. 55 June, 1953 No. 654

A NEW HYBRID DECIDUOUS RHODODENDRON

Mary G. Henry

After having read descriptions of our eastern deciduous Rhododendrons in J. K. Small's "Manual of the Southeastern Flora," I became especially interested in *Rhododendron prunifolium* (Small) Millais, both because its description made it seem attractive and because comparatively little was known about it. Years later when I was able to go to look for it, I called at the New York Botanical Garden and asked Dr. Small about it. He was greatly interested, said he had never seen it growing, and gave me the localities from the three herbarium sheets there, which had been collected in 1924 northwest of Cuthbert, in Randolph County, southwestern Georgia.

In July 1936 search in the localities Dr. Small had supplied did not yield the plant and natives from whom I inquired implied that a red "honeysuckle" did not exist. They had hunted, fished and lumbered all their lives in that part of Georgia and had never seen such a thing. Not discouraged, however, I hunted for and soon found, on July 10, a tiny stream that flowed under pine trees in a small, secluded valley in Randolph County. Following the stream on foot, with the temperature 115 degrees in the shade (the hottest day in the history of the weather bureau in that area), I came in a short time to an opening in the trees just above the stream and there, in a shaft of sunlight, was *Rhododendron prunifolium*, a great pillar of blood-red flowers.[1]

The colony was a small one, some six or eight plants. Being an ardent conservationist did not prevent me from making her-

[1] Small gives the color of this azalea as "crimson" in his "Flora" and a number of others have copied this. The flowers of a hundred or more that I have seen since 1936 (many of them seedlings grown at the Ida Cason Foundation, Georgia) were all a bright blood-red with scarcely any variation in color.

barium specimens for the Academy of Natural Sciences of Philadelphia (PH)[2] (*M. G. Henry 998*) and taking two small plants. Both of these latter have grown successfully on a southern slope at Gladwyne, near Philadelphia, Pa. One is now a sturdy shrub about 8 feet high and nearly 6 feet broad; the other is shorter but much broader. Both flower yearly, providing a brilliant splash of color in midsummer, from about July 12 to August 22. On a second visit to this spot, some very large plants of this species were found. The tallest specimen was 16 feet high, but the largest was 11 feet 8 inches tall and 15 feet 3 inches broad (*Henry 1888*, PH).

A second midsummer-flowering species is *Rhododendron serrulatum* (Small) Millais, a white-flowered plant which often occurs in wet hammocks or along the edges of streams and woods on the coastal Plain from Florida to Louisiana, according to Rehder,[3] and as far north as southeastern Virginia.[4] In 1930 I had brought a young plant of this strong-growing species from Okaloosa County, in western Florida, (*Henry 1344*, PH)[5] to Gladwyne where it has grown well, flowering simultaneously with *R. prunifolium*. The flowers of this plant are rather inconspicuous owing to their small corolla lobes and the fact that usually only a few flowers are open at the same time. It has little to recommend it from a horticultural standpoint, except its late-flowering habit.

These two species of *Rhododendron* have flowered year after year at Gladwyne without ever setting a seed capsule. However, it occurred to me in 1944 that a cross between the two might produce a plant horticulturally valuable in that it perhaps would combine the midsummer flowering habit with pink flowers which would be more appealing in late July than vivid red ones.

Accordingly both *Rhododendron prunifolium* × *R. serrulatum* and the reciprocal cross were tried. The anthers were removed from unexpanded buds and after pollination all other blooms were removed from the twigs. The pollinated flowers were bagged with very fine nylon netting which was carefully fastened

[2] Lanjouw, J. & F. A. Stafleu, Index Herbariorum, Pt. 1. The Herbaria of the World. Regnum Vegetabile, Vol. 2. 1952.

[3] Rehder, A. Manual of Cultivated Trees and Shrubs, ed. 2, p. 722. 1940.

[4] Fernald, M. L., Gray's Manual of Botany, ed. 8, p. 1120. 1950.

[5] This documenting specimen came from the same colony as the 1930 plant but was not made until a subsequent visit in 1938.

with tightly twisted plastic-covered copper wire. Plump seed capsules resulted on both shrubs, but the seed did not ripen until after frost in October.[6] The seeds were planted January 22, 1945, and germinated in 3 weeks. It was soon apparent that the seedlings were intermediate between the parents in leaf and stem characteristics. After a winter in the cold frame and three seasons in a protected trial garden they were planted out. The first hybrid bloomed July 4, 1948; the flowers were a beautiful pink.

About 18 of the hybrids have flowered thus far. In 1952, the first year that they were thoroughly established in the open, there was bloom from July 14 to August 20. There is some variation in the size of the flowers and also in the color and characteristics of the young twigs. One plant bears white flowers (without the slightest spotting or shading of any color) while those of another plant are a warm, light carmine of great brilliance. The intermediate size of the corolla and various vegetative characteristics, particularly those of the young twigs, indicate the hybrid nature of these two plants, however. The remaining hybrid plants are pink-flowered, combining the characteristics of the two parent species. As among almost all seedlings, some flowers are of finer form than others. The largest and finest flowered plants are being used as parents for a second hybrid generation.

There are few important midsummer flowering shrubs for the mid-Atlantic section of the country and I have never seen any of greater beauty or of more exquisite coloring than these vigorous, free-flowering new hybrid azaleas. They appear, moreover, to be quite hardy, for many of them growing on an exposed, windy hillside, without even a mulch of leaves over the bare ground, have been subjected to below-zero temperature without any injury whatsoever. The new hybrid seems to me to be of great horticultural interest and worthy, therefore, of designation other than by hybrid formula. Because it originated at Gladwyne, I propose to call this new azalea *Rhododendron* × *gladwynense*.

[6] It may be of interest to note in this connection that mature seed of *Rhododendron prunifolium* were collected by T. G. Harbison for the Arnold Arboretum in Randolph County, Georgia, in November of 1917, when the leaves were still on the shrubs. Wilson E. H., and A. Rehder, A Monograph of the Azaleas, Rhododendron subgenus Anthodendron. Publ. Arnold Arb. no. 9. p. 170, 1921.

Rhododendron × gladwynense, hybr. nov. (Hybrida inter R. prunifolium (Small) Millais et R. serrulatum (Small) Millais). Ramuli juniores pubescentes; gemmae florales perulis flavido-brunneis margine brunneis albo-ciliolatis apice mucronatis. Folia obovata vel oblanceolata acuta, 2.5–11 cm. longa et 1–3.6 cm. lata, glabra, costa media supra pubescens subtus sparse strigosa, margine ciliolata. Flores mense Julio et Augusto, plerumque 4–7 subumbellati; pedicelli 8–13 mm. longi pubescentes et villosuli pilis glanduliferis. Sepala oblonga, 1–2 mm. longa, margine pilis longis setosis eglandulosis instructa. Corolla infundibuliformis rosea; corollae tubus 2.5–3 mm. longus, extus sparse villosulus pilis glanduliferis, intus pubescens. Stamina filamentis roseis, 5.5–6.5 cm. longis, infra medium pubescentibus. Stylus plerumque quam filamenta ca. 1 cm. longior, 6–7.5 cm. longus, basim versus pubescens; stigma viride. Ovarium dense setoso-strigosum setis eglandulosis.

Young branchlets brown, both minutely pubescent and with scattered longer hairs; floral winter-bud scales glabrous, mucronate or mucronate-aristate, pale yellowish-brown with a dark brown band along the white-ciliolate margin, the mucro often nearly black. Leaves obovate to narrowly obovate or oblanceolate, 2.5–11 cm. long, 1–3.6 cm. wide, puberulous on the midrib above, slightly strigose on the midrib beneath, otherwise glabrous, the margins ciliolate with upwardly adpressed hairs. Flowers appearing after the leaves, July to late August, in 4–7-flowered umbel-like clusters; pedicels 8–13 mm. long, both minutely pubescent and villous with glandular hairs, the distal portion shaded with carmine. Calyx lobes oblong, 1–2 mm. long, ciliate with long, eglandular hairs. Corolla funnelform, moderately glandular-villous without, the lobes grenadine pink (Ridgway) (rarely white or carmine), with or without a barely perceptible salmon-orange blotch within, the tube 2.5–3 cm. long, Rose Doré (Ridgway) (rarely white or carmine), pubescent within. Stamens with filaments 5.5–6.5 cm. long, geranium pink, the lower half pubescent; pollen ample. Style 6–7.5 cm. long, usually exceeding the stamens by about 1 cm., pubescent near the base; stigma green. Ovary densely covered with pale eglandular setae.

TYPE in Herb. Acad. Nat. Sci. Phila.: *Mary G. Henry 6124*, July 22, 1951; also *5982*, July 31, 1950, and *6166*, February 11, 1953; all from the same plant in cultivation at Gladwyne, Pennsylvania.

BRITISH FLORAS ANCIENT AND MODERN

NICHOLAS POLUNIN

THE appearance of the long-awaited new flora of the British Isles[1] seems an appropriate occasion not only to welcome and review the newcomer but also to survey, for fellow members of the Club and other New England botanists, the more noteworthy of the past floras of their ancestral home across the Big Water. From its early days British botany has been endowed with an almost unparalleled concentration of county and other local floras, usually prepared by enthusiastic amateurs and of fair quality. It is not, however, with these that the present notes will in general be concerned but rather with the overall floras of the 'green and pleasant' archipelago.

Nevertheless what has been called "virtually the first Flora of Britain as a whole" was "primarily a record of botanical tours in England and Wales" that, however, "lists all the British plants (nearly 700) at that time known to" its author, being "intended as a prelude to a full-scale Flora which he unhappily did not live to publish."[2] This author was the cavalier and Oxford Doctor of Medicine Thomas Johnson, who died fighting for King Charles I in 1644, and the work concerned was his "Mercurius Botanicus," published in London in 1634 and, as regards a "pars altera," in 1641.[3] Among other works, Johnson edited a fine revision of Gerard's 'Herball' and, "by his own labours, bridged the gulf between the medical herbalists and the Flora-writers who studied plants for their own sake."[2]

Johnson was soon followed by another Oxford graduate and physician, William How (or Howe), who (apparently, though anonymously[4]) published in London in 1650 the "small alphabetical catalogue"[4] entitled "Phytologia Britannica," which Benjamin Daydon Jackson in his "Guide to the Literature of Botany"[3] twice terms (on pages xxxiv and 231) "the first British flora." How (or Howe) was in turn followed by yet another

[1] Clapham, A. R., T. G. Tutin, and E. F. Warburg, "Flora of the British Isles," *Cambridge, England:* Cambridge University Press, pp. liv + 1591, 1952 (7½" x 5", 50 shillings; or $9.50).

[2] Anon., editorial "On Floras," *Endeavour*, vol. 11, no. 43, pp. 115–116, 1952.

[3] Jackson, B. D., "Guide to the Literature of Botany," *London:* Longmans, Green, pp. xl + 626, 1881.

[4] Raven, C. E., "John Ray, Naturalist: his life and works," *Cambridge, England:* Cambridge University Press, pp. xix + 502, 1942.

Oxford graduate and physician in Dr. Christopher Merrett (or Merret), whose "Pinax Rerum Naturalium Britannicarum," issued in London in 1666, also constituted a British flora of sorts, and ran into a second edition the following year.

However, even ardent Oxonians must accord a far greater place in British botany to the Cantabrigian John Ray, who, contending that "the world is glutted with Dr. Merrett's bungling *Pinax*,"[2] published in London in 1670 his "Catalogus Plantarum Angliae, et Insularum Adjacentium," of which a second edition was issued in 1677. The Cantabrigian authors of the new "Flora of the British Isles"[1] contend (p. xi) that this work of Ray's was "the first attempt at a true flora of these islands." As none of the works in question is currently available to me, I cannot express an opinion but only recall the contrary indications cited above: presumably, like so many other controversial matters, it is a question of definition (in this case, what precisely is a flora). However this may be, there can remain no serious question that with his "Catalogus" and supplementary "Fasciculus Stirpium Britannicarum" (London 1688) and subsequent "Synopsis Methodica Stirpium Britannicarum," which was first published in London in 1690 and ran into a second edition in 1696 and a third (recast and edited by the Oxonian Dillenius) in 1724, Ray was the most eminent and widely followed British systematic botanist of his day and indeed for many years after his death in 1705. Nor were there any other types of scientific botanist in that period or for many decades to come, nor successful attempts at better floras.

Actually, it was not until the all-conquering sexual system of Linnaeus swept the botanical world in the middle of the eighteenth century that Ray's works, with practically all others, were thrown into disuse and became little more than historical curios (though often of a fascinating nature). It is also to Ray's credit that the first attempt at a flora of Britain based on Linnaeus's system was a 'Linnaean' arrangement of the third edition of Ray's "Synopsis": the result was the "Flora Britanica: sive, Synopsis Methodica Stirpium Britanicarum," published in London in 1760 by "that curious individual Sir John Hill . . .

[2] p. 112 of "Further Correspondence of John Ray," edited by R. W. T. Gunther, *London:* Ray Society, pp. xxiv + 332, 1928.

but without altering the old descriptive names,"[3] so that, from the point of view of nomenclature, it has to be considered pre-Linnaean!

However, the first worthy response to the demand for an up-to-date British flora along the new Linnaean lines as regards both system and nomenclature soon came from William Hudson, whose "Flora Anglica," first published in London in 1762, ran into a second edition in 1778 and was further reprinted in 1798. This work quickly ousted Ray's "Synopsis" as the standard scholarly account of British plants in general, and had several worthy successors during the period of ascendency of the Linnaean system which lasted well into the nineteenth century. Among the most notable of these was the elder William Withering's "A Botanical Arrangement of all the Vegetables Naturally growing in Great Britain, with descriptions of the genera and species, according to the system of the celebrated Linnaeus," which was first issued in London in 1776 in two volumes, and, as indicated on the title-page, constituted "an attempt to render them familiar with those who are unacquainted with the learned languages," being in fact the first serious flora of Britain written primarily for amateurs. As such it had many successors with which we need not be much concerned; it also enjoyed considerable success that extended over more than a century, being revised again and again under various guises, auspices, forms, and changes of title and authorship until the last edition was published in 1878. (It should here be interjected that, many of the above works, and especially the pre-Linnaean ones, not being at the time of writing available to me, I had to rely in the main on published accounts and catalogues or my own old notes, though fortunately I was able to check most of the points and outstanding references during a subsequent visit to Oxford, England, others being kindly verified by my former pupil Dr. John Burnett, Fellow of Magdalen College, while Dr. E. F. Warburg read and generously approved the manuscript apart from a few very minor alterations which I was happy to make.)

Sir J. E. Smith and James Sowerby's "English Botany," written by the former and beautifully illustrated with no less than 2592 colored plates by the latter, was a more lavish contemporary to those works employing the Linnaean system, its

object being to present for the first time a complete set of colored illustrations of all British plants. The first edition, in 36 volumes, was published in London between 1790 and 1814, after which supplementary parts, prepared by other authors and illustrators, went on appearing until 1866; a second edition, in twelve volumes, was completed in 1846, and a less well illustrated third, but with improved letterpress, edited by John T. Boswell Syme, appeared during 1863–72 (or all dated 1873) in eleven volumes to which a twelfth, on cryptogams and including a general index, was added in 1886, by which time the editor had dropped his last name; further supplementary material appeared later under other auspices.

Meanwhile there had appeared many other general British floras based upon the Linnaean or some reformed sexual system, among which may be noted (1) James Jenkinson's "A Generic and Specific Description of British Plants, translated from the Genera et Species Plantarum of the celebrated Linnaeus" (Kendal 1775) with, however, useful additional locality and other notes, (2) Dr. John Berkenhout's "Vol. II. Comprehending the Vegetable Kingdom" of his "Synopsis of the Natural History of Great-Britain and Ireland," apparently published first in 1770 and running into a "third" edition in 1795, (3) J. Symons's little "Synopsis Plantarum Insulis Britannicis" (London 1798), (4) Dr. John Hull's "The British Flora, or a Linnean Arrangement of British Plants," published in Manchester in 1799, with a second edition in 1808, (5) Sir J. E. Smith's "Flora Britannica" in three volumes (London 1800–04), republished in Zürich in 1804–05 with additional localities, (6) John Galpine's "A Synoptical Compend of British Botany . . . arranged after the Linnean System" which was first published in Salisbury in 1806 and had further editions up to the fourth, published in London in 1834, (7) Dr. R. J. Thornton's "The British Flora . . . arranged after the Reformed Sexual System," published in five volumes with accompanying illustrations (London 1812), (8) Sir J. E. Smith's "The English Flora," of which the original four volumes on vascular plants were published in London during 1824–28, followed by a second edition in 1828–30, and, later, by a fifth volume in two parts (on Fungi by M. J. Berkeley and on the other non-vascular cryptogams by W. J. Hooker), (9) the

last-named's "British Flora" (*see* below), and (10) Dr. Richard Deakin's "Florigraphia Britannica," published in four volumes in London during 1841–48, and of which a new edition appeared in 1857.

Already some decades before these later dates the so-called natural system of classification had begun supplementing the sexual one originally established by Linnaeus. Noteworthy at an early stage was S. F. (no relation) Gray and his son J. E.'s[6] "A Natural Arrangement of British Plants, according to their relations to each other," published in two volumes (of which the second was on vascular plants) in London in 1821 and surprisingly enough not acknowledged in its less weighty successor, Professor John Lindley's "A Synopsis of the British Flora; arranged according to the Natural Orders," which appeared eight years later and of which a second edition was issued, also in London, in 1835, and a third in 1841. This last was reprinted and republished in London in 1859 (by "Longman, Brown, Green, Longmans, & Roberts" according to a copy in the Gray Herbarium, though it is interesting to note that B. D. Jackson, writing in London in 1881 (p. 235) when Secretary of the Linnean Society, was unable to find a copy[3]).

In spite of the undoubted merit of the Grays' and some other works, the general floras which largely guided British field botanists and others interested in the flora of the British Isles for the remainder of the nineteenth century and the first half of the twentieth—indeed until the publication last year of the new 'Cambridge' flora—were due primarily to George Bentham, the Hookers (father W. J. and son J. D.), and C. C. Babington. These remain among the greatest names in British (as often they do in world) botany, and as indeed seems the more right and proper when we recall that to them, still, systematic work comprised practically the whole of plant science. However, Bentham should not be credited with introducing the use of keys to British floras, as he was by his fellow Cantabrigians,[1] for effective ones to the families and genera were employed many years earlier in the works of the Grays and John Lindley cited above, being a rather natural outcome of the change from the Linnaean system, while clear keys to the species appeared in Dr.

[6] cf. *Journal of Botany*, **13** (N. S. 4), p. 127, 1875.

D. C. Macreight's "Manual of British Botany; in which the orders and genera are arranged and described according to the natural system of De Candolle; with a series of analytical tables for the assistance of the student . . . ," published in London as early as 1837.

Happily surviving the change from the Linnaean to the natural systems of classification and cleverly outriding the controversies involved was W. J. Hooker's "The British Flora," of which the first edition was published in London in 1830 and three others appeared within the decade. While these early editions were based upon the Linnaean system, they contained increasingly detailed appendices dealing with the natural system; in such an appendix in editions 3 and 4 "the British Genera are referred to their respective *Natural Orders*." The fifth edition, published in London in 1842, was arranged according to the natural system, after an introduction in which the Linnaean system was used as a kind of index to the natural one, and the subsequent three editions, prepared by Hooker and G. A. W. Arnott, and published in London in 1850, 1855, and 1860, respectively, so well maintained this tradition that according to B. D. Jackson[3] "'Hooker and Arnott' was long the text-book of British field botanists." In view of what has been said above and of the full explanations given in subsequent editions, it scarcely seemed fair for Jackson (*op. cit.* p. 235) to remark that the fifth edition "was altered to the Natural System without the slightest comment thereon," especially as Hooker specifically remarked in his introduction to that edition (p. v) that "The Linnaean Method is . . . preserved, as an easy introduction to a knowledge of the more important or Natural Method." It should be noted that the third, fourth, and fifth editions are indicated as "vol. I," the other volume being made up of the works on non-vascular cryptogams comprising also vol. 5 of Sir J. E. Smith's "The English Flora"—*see* above.

Babington's "Manual of British Botany, containing the flowering plants and ferns arranged according to the natural orders," first appeared in 1843. It was followed by a worthy succession of further editions, in similar format and likewise published in London, by the original author up to the eighth (1881), and then by a ninth (edited by H. and J. Groves) in 1904 and a tenth

(edited by the late A. J. Wilmott) in 1922; this last, in particularly handy pocket size, is still the constant companion of numerous British (and some other) botanists in the field. Meanwhile there appeared its rather larger and less technical rival "for the use of beginners and amateurs," Bentham's "Handbook of the British Flora; a description of the flowering plants and ferns indigenous to, or naturalized in, the British Isles," which was first published in London in 1858, had admirably clear keys to the species, and was followed by further editions up to the fourth, issued in 1878, as well as by an illustrated version in two volumes published in London in 1865. After Bentham's death in 1884, further editions of the now famous "Bentham and Hooker" were revised by J. D. Hooker (up to the seventh, published in London in 1900), and there was even a further "*Seventh Edition* revised by A. B. Rendle" issued as recently as 1924. As a useful companion to what was originally Bentham's "Handbook" there was published in London, after the exhaustion of his illustrated edition, a separate book of "Illustration of the British Flora" by W. H. Fitch and W. G. Smith, commencing with a first edition in 1880 and ending with a fifth in 1901, to which were later added "Further Illustrations of British Plants" by R. W. Butcher and F. E. Strudwick (published in Ashford, Kent, in 1930). The younger Hooker also prepared "The Student's Flora of the British Isles," a useful work with clear descriptions, first published in London in 1870 and followed by further editions in 1878 and 1884; it received wide acclaim for general accuracy and conciseness, and the last edition is still in considerable use today.

Other overall floras etc. of the British Isles issued during the past century in which the natural system has held almost undisputed sway include (1) "The London Catalogue of British Plants," a check-list first prepared supposedly by H. C. Watson and published in 1844, which was subsequently revised and issued in various forms as further editions, latterly by other workers, up to the eleventh which appeared in 1925, and was the most enduring and influential compilation of its particular kind, although worthy early rivals were published in Cambridge and Edinburgh (several editions), and, for once much later, in Oxford, where G. C. Druce's "List of British Plants" appeared in 1908, to be

followed by a second edition (entitled "British Plant List" and published at Abroath) twenty years later, (2) C. A. Johns's classic (but 'popular') "Flowers of the Field," first published in two volumes in London in 1853, which proved so lucid and attractive that no fewer than 29 editions were called for before the end of the nineteenth century, and more appeared in the twentieth, as well as, earlier, a number of editions of Johns's companion work "The Forest Trees of Britain," which first appeared in two volumes in 1849, (3) Robert Hogg and George W. Johnson's "The Wild Flowers of Great Britain," illustrated with fair hand-colored plates and published in London in 9 volumes during 1863–80, (4) W. R. Hayward's "The Botanist's Pocket-Book, containing in a tabulated form the chief characteristics of British Plants," of which the first edition was published in London in 1872, followed by others up to the nineteenth which appeared in 1930 and of which the fourth printing is still being advertised (and used) and, like other recent ones, was revised by the late Dr. G. C. Druce at Oxford, (5) Anne Pratt's "The Flowering Plants and Ferns of Great Britain," with good if often congested colored plates, published in London in five volumes in 1855, of which what seems to have been a third edition was issued in six volumes in London in, apparently, 1873, (6) Frederic N. Williams's partial and unimplemented "Prodromus Florae Britannicae," of which ten parts were published during 1901–12 but apparently no more, (7) Dr. C. E. Moss's also unfortunately abortive "The Cambridge British Flora," of which the lavish if crotchety volumes 2 and 3, on various groups of Apetalae and Polypetalae, appeared in 1914 and 1920, but that was all, (8) A. R. Horwood's ecologically-based, 6-volume work on "British Wild Flowers in their Natural Haunts," published in London apparently in 1919 and usefully illustrated though uncritical and, like some less sumptuous works which have not been cited here, concerned with only chosen examples from the British flora, (9) Dr. G. C. Druce's valuable "The Comital Flora of the British Isles," published at Abroath in 1932, which is still in wide use though needful of revision, (10) such partial floras, omitting many rare or critical species, as various 'school' and 'student's' ones, including C. T. Prime and R. J. Deacock's recent "The Shorter British Flora," published in London in 1948, (11) such 'popular' (though scientifically

based) or special-angle works as L. J. F. Brimble's eminently readable "Flowers in Britain" (London 1944) and "The Floral Year" (London 1949), or Dr. John Hutchinson's "British Flowering Plants: evolution and classification of families and genera, with notes on their distribution," published in London in 1948, and (12) the "Biological Flora of the British Isles," which has been appearing in the *Journal of Ecology* since 1941 and, as "It is hoped that [it] will eventually become a complete account of the biology of all British Flowering Plants, Conifers, and Pteridophytes, including naturalized aliens," seems appropriate for mention here—especially as it has been pushed on energetically and latterly with increasingly happy results—although it is a flora of a very different kind from those previously mentioned, or, for that matter, heretofore seriously attempted.

In addition to the above already very heterogeneous assemblage of more or less overall works on the British vascular flora (purely cryptogamic works have in general been ignored), there have been scores and indeed probably hundreds of others, usually of less weight or significance, besides very many more county and other local florulae. For in the countries of northern Europe, including the British Isles, it is happily common for a considerable proportion of country dwellers with education, and many others with little or none from books, to take a healthy interest in the plants that form so vitally important a part of their environment.

Thus was the stage well set for the production of the new (or, as it seems likely to be called, "Cambridge") "Flora of the British Isles";[1] nor are those who have so long awaited its arrival likely to be disappointed with this work, unless it be in minor connections, some of which will be mentioned below. To begin with the whole is well executed and well produced, and above all was badly needed; for in spite of the numerous forerunners, of one sort or another, mentioned above, the situation is fairly indicated by Professor Sir Arthur Tansley when he opens his lucid foreword by writing "A new British Flora has been a desideratum for the past half century and urgently needed during the last thirty years." Nor can there be any question about the total authority with which the trinity of authors write; for although not all primarily taxonomists they are, to quote again from the fore-

word, men "all with the modern training, all keenly interested in plants as they grow in the field, in ecology and genetics [so that a] comparison of their book with any of the previous Floras will make plain the distance that has been traversed since those were written." Obviously it will become the indispensable field companion of numerous academic and other botanists as well as of newer students and enlightened amateurs (for whom it is primarily intended), and will be thumbed over in herbaria, laboratories, and homes for many years to come.

A comprehensive and reasonably up-to-date flora being an essential tool for the effective study in any area of its different kinds of plants, and economically important because of the dependence of mankind very largely on plants for the wherewithal and amenities of life, it is particularly gratifying to find this flora in some respects as 'modern' as could be desired, indicating chromosome numbers (where known), Raunkiaer life-forms, edaphic and other habitat preferences, with frequent admissions of taxonomic entanglements or even doldrums such as all perceptive students meet but not all so readily admit. The ecological notes are often particularly well and concisely written. Other commendable points are the 'Ekskursionsflora' form and convenient 'pocket' size (though not thickness, which the publishers claim to be 2 inches), waterproof cover (tested by this reviewer) against ordinary rainy days but one still wonders about the effect of the inevitable soakers), decapitalization of all specific and 'lower' epithets (though the repetition in each case of the capitalized form serves no evident purpose and uses valuable space), wide use of subspecies (though some critics have objected to this and one has commented *inter alia* that "*Galium palustre* ssp. *tetraploideum* is surely a case where valour has stolen a march on discretion!"),[7] and the sprinkling of line drawings (though some of these have captions in the wrong places or could be improved in quality, and one looks forward to the promised companion volume of illustrations).

As this book has already been hailed with wide approval, which it richly deserves, it would seem time to indicate, now that its future is assured, some of the more obvious ways in which it seems, at least to this reviewer, that further editions might be

[7] Meikle, R. D., "A new British Flora," *Kew Bulletin*, No. 2 for 1952, pp. 252–254, 1952.

improved. These items are in almost all respects relatively minor, and certainly do not seriously detract from the merit and value of the work as a whole; they are rather of the nature of suggestions (one hopes constructive) which such a worthy effort can well stand, *plus* a few of the grumbles that seem to be inevitably raised against any major work (as none can be perfect for all men!). Some of these have already been indicated above, and more are given in the pithy review of Meikle,[7] who, however, seems to go too far in condemning the text-figures as "generally poor, and sometimes . . . downright misleading. They should be completely revised, or else altogether omitted, in future editions."

It was quite a shock even to the present, distant devotee of the British flora to find in this book, published well on in 1952, no mention whatever of the two most important discoveries of recent years in the flora of the British Isles, namely those of *Koenigia islandica*, a genus new to Britain, and of *Diapensia lapponica*, a family new to Britain: the former was announced in 1950 from material collected in 1934, the latter in 1951,* and both were subsequently confirmed. Each discovery has been the subject of at least two special papers and, in addition, notice in the daily press as well as incidentally in other botanical works: yet they could well remain unknown to the newcomer. Latterly it seems to have become generally agreed that "both are undoubtedly native on remote hills in Scotland."[8] The explanation of this surprising and unexplained omission is obviously that the book was an excessively long time in the press, as is indeed indicated by the references to "Professor A. G." Tansley (he was knighted very early in 1950); but surely the authors owed it to their dependents (for such are indeed hosts of British botanists) at least to insert an *addenda* slip including such items.† Nor are

[8] Lousley, J. E., "The Changing Flora of Britain," *Nature*, **169**, pp. 1076–1079, 1952.

* Also announced in 1951 (e. g. *Nature*, **168**, p. 934) and further in 1952 (*Watsonia*, **2**, pt. 4, p. 237) was the confirmation of *Homogyne alpina* in Scotland, while very recently Sir Christopher Cox, Fellow of New College, Oxford, has added *Artemisia norvegica* to the known British flora—so some blank pages for notes at the back of the next edition of the work under review would seem likely to be welcome! These and some other very recent finds are reviewed by J. E. Lousley in *Nature* (**171**, pp. 335–337. 1953).

† While this review was in proof there was published in *Nature* (**171**, p. 333, 1953) a notice to the effect that "a list of errata so far discovered in the first edition" is available free of charge from the Cambridge University Press, Bentley House, 200 Euston Road, London, N. W. 1, England.

they absolved by dating their acknowledgments "November 1948," as their own bibliography includes later works! In this age when all too many books are liable to be outdated before publication, there is still no scholar's excuse for not maintaining vigilance against such happenings—as is indeed all the more to be expected with key works of reference.

Turning to that bibliography, it is disappointingly slender and, at least for the 'outsider,' inadequate. Particularly striking is the omission of any county or more local floras, in which the British Isles happily abound, and which are rendered little if at all less necessary by the publication of this modern overall work (though the latter may well stimulate local authorities to the preparation of some new and better local floras). Quite apart from their seeming desirability in the bibliography, a brief but critical survey of British local floras would be a valuable addition to future editions if, as evidently is the case, the authors are anxious to give the most possible help to their public. In view of the inclusion of Tansley's monumental "The British Isles and their Vegetation," there is less need for reference to other ecological works, though it should be remembered that the studies of flora and vegetation are scarcely separable, and that the *Journal of Ecology* is now an awfully long series to look through!

While the general editing is on the whole commendably uniform —a charming tribute by the other two authors indicates that this labor, and the main responsibility for the work as a whole, lay with Professor T. G. Tutin—it would not seem ungracious, in view of the authors' own admissions, to express the hope that future editions may be more uniformly critical—with, moreover, at least brief notice of more of the lower intraspecific taxa. Thus whereas the tendency has been to draw family (and sometimes generic) limits very narrowly, which already some users will deplore (especially where it introduces such names as *Chamaepericlymenum* for the familiar *Cornus*, or *Chaenorrhinum*, *Kickxia*, etc., for *Linaria*), specific lines are apt to be quite evidently (sometimes painfully so) left to individual opinion or some much earlier judgment. In the words of one reviewer,[7] "The fact that the Flora is a product of triumviral ingenuity has perhaps been the cause of . . . inconsistency which will be painful to those who find comfort in the uniformity of a single botanical outlook."

But further study and perhaps closer cooperation in the future should improve this, even as it must remain impossible of complete remedy so long as species continue to be a matter of personal judgment: the message in this case, as in connection with the worst taxonomic tangles, is chiefly one of sympathy!

On the other hand New England botanists who may have seen reviews in which this work was hailed as "Herculean" and "definitive" will smile, knowing that no overall flora can be the latter and, in the former connection, inevitably comparing it with their own maestro's recent solo (though aided by others, as were even Clapham, Tutin, and Warburg) revision of Gray's 'Manual,' which is virtually a new work of the order of three times the length of this one, deals with over 8,000 specific and allied entities, and yet has nearly 2,000 illustrations—which brings us to the specific grumble of cost, as the retail price of the two books in the United States is precisely the same! Although the standard print is smaller in this eighth edition of Gray's 'Manual,' the layout tends to be clearer than in the work at present under consideration, and the important features better emphasized—in the keys as well as in the descriptions, from which a good deal of unimportant detail and repetition is omitted with distinct advantage in Gray's 'Manual.'

As for the generic 'splitting' implied above, this is a matter which, according to most mature taxonomic judgment, should only be perpetrated after extensive study of all involved entities throughout their range. Quite apart from the distressing (except to the combination-mongers) name-changes which such segregation demands, it is remarkable how often groups which are distinct in one geographic area are confluent in another, and whereas with all species such considerations do not seem decisive in view of modern knowledge of biotype content, introgression, and population statistics, one would like to think that with genera they still should be.

In the absence of general agreement among scientists, the order to be followed in such a work is admittedly largely a domestic question, like the security 'screening' of an individual; nevertheless many visitors to the British Isles, overseas students who will inevitably have to use this book, and probably many academic British botanists, will surely wish the authors had

taken this opportunity to break more basically with local tradition in using a sequence of families and major groups at least more in keeping with that to which infinitely more people in the world are now accustomed. But perhaps the present authors are following the practice of the elder Hooker (*see* above), and their switching of the Pteridophyta and Gymnospermae and dropping of the Charales prelude further fundamental changes for the future; or perhaps the fact that they are referred to on the dust-jacket as "editors" should warn the reader not to expect too many enterprising innovations.

The uninitiated should note that the literature citations after the authors of species are to worthwhile and easily-accessible illustrations; otherwise they may sometimes look like references to original publications of combinations by the second author (as on p. 1321). Is it too much to hope that botanists may some day follow their zoological colleagues and get away from the citation of mere combination-making 'authorities,' thereby presumably reducing the combination-mongering which still seems to be indulged in in certain quarters?

The work on the whole seems to be commendably free from misprints and *lapsi calami*, though the seemingly inevitable sprinkling occur, and more attention might perhaps be given in future editions to the choice and bestowal of English names, which certainly have their use among the many (yes, often very worthy!) laymen who are 'put off' by Latin ones. There is also occasional inconsistency in spelling, e. g. of "caespitosus" (regardless of any Linnaean origin). Other tiny items that nevertheless strike the eye include *Erodium cicutarium* (L.) L'Herit. (not simply "L.") and *Arenaria uliginosa* Schleich. in* Lam. & D. C. (not simply "D. C."). This last item recalls the 'International Rules' (and recommendations) with regard to citation of authors, which might well be studied for consistency etc. in many instances for the next edition, though how many of us really follow them anyway! Some of the names used appear also to be in contravention of the Rules, even regardless of the changes voted in 1950 at the Stockholm Congress. A glorious 'howler' is the *Ribes* fruit which is given on page 588 as "globose or ovoid, 10–20 cm." (in diameter?), to which is added (as if in case of incredulity) that it is "more in cultivated forms."

* The use of *apud* was voted down at the Stockholm Congress.

On the whole the extra-British geographical ranges of species are well done, though it might be suggested that with regard to such a unit as Greenland it be either consistently mentioned (when applying) or omitted as a matter of policy (and in that event included, say, with North America). Its present inclusion in many instances and exclusion from many others is apt to make the uninitiated think that exclusion from mention in a particular case means that the plant in question is absent therefrom, whereas this is often not the case (for example among aquatics, *Hippuris vulgaris* is found practically throughout North America, *Sparganium angustifolium* was described therefrom, and three of the British species of *Callitriche* are known to occur in Greenland).

Evidently realizing that it is humanly impossible in preparing a work of this kind to revise a large amount of extra-territorial material (even if it is available) of almost each and every species, and moreover dangerous to rely too widely on unverified literature citations, the authors have wisely been cautious in their indications of geographical range and have at least avoided the worse pitfall of indicating all sorts of 'presence' that has in fact not been authoritatively reported or confirmed. Except for rare or restricted species, indications of ranges within the British Isles are chiefly given by 'lumping' the number of vice-counties in Great Britain (total 112) and Ireland (total 40). In view of the fact that Druce's "Comital Flora" is now over twenty years old and largely outdated, and indeed often more up-to-date and accurate records are available than have been used in the present flora, it is to be wondered whether it would not be possible in future editions of the latter to indicate which vice-counties are involved (or omitted in the case of a nearly 'full house'), as this, with an appropriate map and explanation (which would also be useful additions to future editions), would at once give a good idea of the distribution of each species in the British Isles and, incidentally, stimulate the admirable sport of hunting for 'filling in' in the future. Among distributional errors may be noted the statements that *Geum rivale* is not found in arctic Russia, whereas it occurs well north on Kanin Peninsula,[9] and that *Alchemilla alpina* occurs in Spitsbergen (not Spitzbergen), where it is unlikely ever to be found; a curious one is that on p. 124, where

[9] Andreev, V. N., "Material k flore Severnogo Kanina," *Trav. Mus. Bot. Acad. Sci. U. R. S. S.*, **23**, pp. 147–196, 1931.

Chelidonium majus is indicated as occurring in 17 vice-counties in Great Britain and 60 in Ireland (which has only 40). Druce in the "Comital Flora" already gave 96 in Great Britain and all 40 in Ireland.

These items are all more or less minor and, as has already been emphasized, do not detract from the general merit and value of this book whose publication is a considerable event in European botany. It is merely hoped that when further editions are called for, as they surely will be, consideration of such matters will help in the further striving for perfection. Meanwhile we can consider the problem of a working British flora as solved for the time being, and its future in good hands.—Gray Herbarium of Harvard University, Cambridge, Massachusetts.

ADDITIONS TO THE FLORA OF THE ERIE ARCHIPELAGO (ONTARIO)[1]

Bernard Boivin

Cursory checking of the recently published Flora of the Erie Islands by E. L. Core (1948) has shown that our herbarium contains quite a few additions to the known flora of these islands, particularly of Middle and Pelee Islands. They are listed below, those marked with an asterisk (*) being new to the flora of the Archipelago.

New to the Flora of Pelee Island

Abutilon theophrasti Med., W. Botham, Aug. 1938.
**Acer spicatum* Lam., W. Botham, 1938.
Acnida altissima Riddell, W. Botham, 1938.
**Agrimonia pubescens* Wallr., W. Botham, 1938.
**Ambrosia psilostachya* DC. var. *coronopifolia* (T. & G.) Farw., W. Botham, 1938.
Amphicarpa bracteata (L.) Fern. var. *comosa* (L.) Fern., W. Botham, 1938.
**Anaphalis margaritacea* (L.) C. B. Clarke var. *intercedens* Hara, W. Botham, 1938.
Arabis perstellata E. L. Br. var. *perstellata*, W. Botham, 1938.
**Aster ontarionis* Wieg., W. Botham, 1938.
**Bidens vulgata* Greene, W. Botham, 1938.
Boehmeria cylindrica (L.) Sw., W. Botham, 1938.
Campanula americana L., W. Botham, 1937, Aug., 1938.
Cardamine pensylvanica Muhl., W. Botham, June 6, 1938.

[1] Contribution No. 1211, Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada.

***Ceanothus ovatus* Desf., W. Botham, June 6, 1938.
Corydalis flavula Raf., H. A. Senn 1057.
***Cuscuta campestris* Yuncker, W. Botham, 1938.
Digitaria sanguinalis (L.) Scop., W. Botham, 1938.
Dryopteris campyloptera (Kunge) Clarkson, W. Botham, June 6, 1938.
***Echinocystis lobata* (Michx.) T. & G., W. Botham, 1938. This species had been reported for the islands by Dodge, p. 95, but this report is questioned by Core, p. 91, who pointed out that it could have easily been confused with *Sicyos angulatus* L. which is common. The present specimen shows the characteristic deep angular leaf sinuses and racemose inflorescences of *Echinocystis lobata*.
**Erysimum repandum* L., W. Botham, 1938.
**Equisetum arvense* L. var. *boreale* (Bong.) Led., Botham, 1938.
Erechtites hieracifolia (L.) Raf., W. Botham, 1938.
**Floerkea proserpinacoides* W., H. A. Senn 1162.
**Galium circaezans* Mx. var. *hypomalacum* Fern., W. Botham, June 6, 1938.
Geranium carolinianum L., W. Botham, Aug., 1938.
Gnaphalium obtusifolium L. (= *G. polycephalum* of Core's list), W. Botham, 1938.
**Helianthus strumosus* L., W. Botham, 1938.
**Heracleum lanatum* Michx., W. Botham, 1938.
Hydrophyllum appendiculatum Michx., W. Botham, June 6, 1938.
Lactuca floridana (L.) Gaertner var. *floridana*, W. Botham, 1937.
**Lithospermum linearifolium* Goldie, W. Botham, June 6, 1938.
Lobelia inflata L., W. Botham, 1938.
**Lycopus americanus* Muhl., var. *scabrifolius* Fern., W. Botham, 1938.
Lycopus virginicus L., W. Botham, 1938.
Lysimachia nummularia L., W. Botham, 1938.
**Panicum flexile* (Gatt.) Scribner, W. Botham, 1938.
**Physalis subglabrata* Mack. & Bush, W. Botham, August, 1938.
Polygonatum biflorum (Walt.) Ell., W. Botham, 1938.
**Polygonatum pubescens* (W.) Pursh, W. Botham, 1938.
Polygonum aviculare L., var. *littorale* (Link) Koch, W. Botham, August, 1938.
Polygonum coccineum Muhl., W. Botham, 1938.
Polygonum convolvulus L., W. Botham, 1938.
Prenanthes alba L., W. Botham, 1938.
Rorippa islandica (Oeder) Borbas var. *hispida* (Desv.) Butt. & Abbe, W. Botham, 1938.
**Rudbeckia laciniata* L., W. Botham, August, 1938.
Rumex acetosella L., W. Botham, 1938.
Smilacina racemosa (L.) Desf. var. *racemosa*, W. Botham, 1938.
**Sonchus arvensis* L. var. *arvensis*, W. Botham, 1938.
Stellaria media (L.) Cyr., W. Botham, June 6, 1938.
Teucrium canadense L., W. Botham, 1938.
**Verbascum blattaria* L. f. *albiflora* (Don) House, W. Botham, 1938.
**Verbena stricta* Vent., W. Botham, 1938.
Veronica arvensis L., W. Botham, June 6, 1938.
Vinca minor L., H. A. Senn 1160A.
**Viola pensylvanica* Michx., H. A. Senn 1135.
**Viola pensylvanica* Michx. var. *leiocarpa* (Fern. & Wieg.) Fern., W. Botham, 1938.

These 56 additions bring to 506 entities the known flora of Pelee Island.

New to Middle Island

Arisaema atrorubens (Aiton) Blume f. *zebrinum* (Sims) Fern., H. A. Senn 1084A (with f. *atrorubens*).
Cardamine douglasii (Torrey) Britton, H. A. Senn 1081.
Dentaria laciniata Muhl., H. A. Senn 1080.
Juncus dudleyi Wiegand, H. A. Senn 1096.
Quercus macrocarpa Michx., H. A. Senn 1093.
Ribes americanum Miller, H. A. Senn 1074.
**Salix rigida* Muhl., H. A. Senn 1109.

These bring the known vascular flora of Middle Island to 113 species. Also the total number of species and varieties known for the Archipelago is increased to 847, that is 29 more than the 818 reported by Core.

W. Botham was, I believe, a school teacher, amateur botanist and resident of the island who sent us a number of his 1937 and 1938 collections for identification. Dr. H. A. Senn's additions are the result of a short trip to Pelee and Middle Islands in 1939. —Division of Botany and Plant Pathology, Science Service Building, Agriculture, Ottawa, Canada.

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Dodecatheon amethystinum and forma margaritaceum in the Missouri Ozarks.—When Dr. Fassett published his account of 'Dodecatheon in eastern North America' (Am. Midl. Nat. **31:** 455–486. 1944), he showed that the range of *D. amethystinum* Fassett was limited to unglaciated areas. At that time the southwesternmost station for the species was near Hannibal, northeastern Missouri. As has been previously suggested by the writer (Rhodora **42:** 102. 1940; **44:** 74. 1942), the Hannibal area, together with adjacent portions of Marion, Ralls, Pike, and Lincoln counties, shows every evidence of having escaped Pleistocene glaciation, and, on the basis of its flora alone, can be considered as another "Driftless Area" and as a part of the Ozark region.

During 1950 and 1951 *D. amethystinum* was found in new localities considerably farther south and west of the Hannibal

station and well into the Ozark region. This species was observed at three separate stations in Cole, Osage, and Dallas Counties. Cole and Osage Counties border the south side of the Missouri River near the northern edge of the Ozarks, while Dallas County is one of the Ozark border counties on the west separating the rough forested Ozark region to the east from the Prairie Province on the west. At each of these stations the shooting stars were very abundant on steep north-facing limestone bluffs. At all these stations, the capsules were found to be thin-walled and narrowly cylindrical, the leaves were pale green with conspicuously dentate or repand-denticulate margins, and the petioles either not red or with only a trace of reddish at the base—all characteristics of *D. amethystinum.* Dr. Fassett has seen these collections and concurs with me that they are referable to *D. amethystinum.*

At one of these stations the corollas, in hundreds of plants observed, were predominantly lilac or orchid-pink, while at another station the flowers were predominantly white or with only a lavender ring at base. This white form (f. *margaritaceum* Fassett) has not previously been recorded from Missouri, and Fassett observes (Am. Midl. Nat. loc. cit. p. 475) that "albinos are very rare" in this species.

It is interesting to record, then, that *D. amethystinum* is found in the unglaciated Ozarks south of the Missouri River and that its other Missouri station at Hannibal is in a "Driftless Area."

The Missouri collections are:

DODECATHEON AMETHYSTINUM Fassett. *Steyermark 69756*, north-facing slopes with limestone above bordering Missouri River, T 45 N, R 8 W, sect. 10, 1½ mi. west of Chamois, Osage Co., May 20, 1950, "corolla predominantly lilac or orchid-pink"; *Steyermark 71468*, base of moist limestone north-facing bluffs, along Niangua River, T 34 N, R 18 W, sect. 8, 1½ mi. south of Windyville, Dallas Co., June 2, 1951.

DODECATHEON AMETHYSINUM, forma MARGARITACEUM Fassett. *Steyermark 69732*, in moist crevices of bluffs, on steep shaded slopes above bluffs and at base, north-facing steep wooded bluffs with limestone at top along Missouri River, T 44 N, R 10 W, sect. 16, just north and northwest of Osage City, Cole Co., May 20, 1950, "flowers predominantly white with lavender ring at base."—JULIAN A. STEYERMARK, CHICAGO NATURAL HISTORY MUSEUM and MISSOURI BOTANICAL GARDEN.

Filago arvensis in Michigan: A Second North American Record.—This small annual weed of southern and central Europe and southwestern Asia (Hegi, Illustrierte Flora von Mittel-Europa VI/I: 454, 1918) was found at Kitchener, southeastern British Columbia, July 31, 1942, and again at the same place and nearby in 1943 (George A. Hardy, "*Filago arvensis* in North America," Rhodora 47: 258, 1945). On July 17, 1952, I found a few plants along an unpaved road a quarter mile east of Pellston, Emmet Co., Michigan—one several-stemmed branched plant 30 cm. high on the ditch bank, several smaller (10–20 cm. high) simple or nearly simple ones (f. *subsimplex* Rouy) in quack-grass sod along the adjoining fence row, in sandy and gravelly soil. The material (*Shinners 13536*) has been divided between the Herbarium of Southern Methodist University and that of the University of Michigan. This species is not mentioned in the new Gray's Manual, nor in the current floras of Ryberg (of the prairies and plains, and the Rocky Mountains), Small (southeastern states), Jepson (California), or Peck (Oregon) It is worth noting that although the plant was not found with *Centaurea diffusa* Lam., that, as yet very localized European introduction, grows in Emmet and adjacent Cheboygan counties, quite abundantly in some places, and apparently is spreading rapidly. However, the most prominent introduced plant associated with *Filago arvensis* was the American *Grindelia squarrosa* (Pursh) Dunal, which was found at the same locality in 1920 (Gates & Ehlers, "Annotated List of the higher Plants of the Region of Douglas Lake, Michigan," Pap. Mich. Acad. Sci. 4: 2761, 924).—Lloyd H. Shinners, Southern Methodist University, Dallas, Texas.

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DRABA ON CLAY BUTTE, WYOMING

Reed C. Rollins

Hardly more than half a mile from Beartooth Butte, noted for the deposition there of Lower Devonian fossil plants (Dorf, 1933), is Clay Butte. These Buttes (really "flat-topped" mountains) situated in the extreme northwestern corner of Park County, Wyoming, and not far east of Yellowstone Park, are made up of a variety of clays, basic shales, and rocks somewhat in contrast to many of the primarily granitic mountains of the surrounding area. Clay Butte, as Professor C. L. Porter of the University of Wyoming and I were to discover, is a real mecca for anyone interested in the genus *Draba*. In two days of botanizing on this 10,300—foot mountain in early August, 1951, we covered the varied habitats of the broad approaches to the highest part of the Butte and collected fifteen numbers of *Draba* representing eleven different species. Later in the month Professor Porter made several additional collections from more northerly stations on the Butte. Some of these latter collections are mentioned below in addition to those made earlier. Not only was there an unusually large number of species on Clay Butte, but in most instances there were thousands or hundreds of thousands of individuals of each species. *Draba* was found in a wide range of habitats, including such extremes as rock chimneys, steep clay slopes, and nearly bare "snowdrift-melt" areas. An exceedingly wide range of variation is demonstrated by the samples of several populations of *D. incerta*, and others of the collections made are of special interest. Some problems have arisen in connection with the identity of the specimens taken, and it is my present purpose to deal with these and to mention specifically the nature of the variation encountered. The material collected was ample for most of

the numbers, there being an abundance of plants at nearly every location.

Draba oligosperma Hook. Three collections are referable to this species which grows in exposed situations. *Rollins & Porter 51273* was collected on a ridge-top and the plants were of the "pincushion" type with densely congested leaves and short scapes, 1–3 cm. long. The siliques in this collection are nearly orbicular in outline, though tapered above, and range from being well-covered with simple recurved trichomes to nearly glabrous. *Rollins & Porter 51270* came from a slightly less exposed situation and the plants were less compact. They formed mats up to six inches in diameter and the scapes varied from 3 to 6 cm. high. The silique-shape among these plants varies from nearly orbicular in outline to slightly longer than broad and they are densely to sparsely covered with simple recurved trichomes. Three plants of this collection with more elongate fruits, pubescent pedicels and branched trichomes upon the fruits are of special interest and are discussed below. A third collection made by Porter (no. 5884) is quite similar to no. 51270, and a fourth, from nearby Beartooth Butte, made in 1939, *Rollins & Muñoz 2840*, is very similar to no. 51273.

Down the slope from the ridge-top where *D. oligosperma* was found were plants of a closely related species collected as no. 51269. These have elongated siliques that are rounded above, tapered below and covered with "doubly pectinate" appressed trichomes on the valve surfaces. The shape differs markedly from the broad fruits of *D. oligosperma* which are rounded below, tapered above, and covered with simple recurved trichomes. Also, the longer pedicels and scapes are pubescent instead of glabrous, as in *D. oligosperma*, and the petals are white instead of yellow. Though closely related to the latter species, there is a pattern of distinctive characteristics that shows these plants are not the same. Below, the plants are described as *D. pectinipila*.

This new species is in contact with *D. oligosperma* and there is evidence that some hybridization occurs. This evidence comes from three plants collected near the point of contact on Clay Butte where nos. 51269 and 51270 were taken. One of the three shows a mixture of simple and branched trichomes on the valve surfaces, with considerable variation from one silique to another.

Also, the siliques are broader and less elongated than is characteristic of *D. pectinipila.* The other two plants are more compact than is usual for *D. pectinipila,* but this is not surprising since they were growing in a more exposed situation. One of the two has nearly glabrous pedicels but they are otherwise much alike and fit *D. pectinipila* very well. These three plants have been placed in the Gray Herbarium under no. 51270a.

Draba pectinipila Rollins, sp. nov.

Deep-rooted soboliferous perennial; caespitose, clumps 2–4 inches across; caudex loosely matted, highly branched; leaves tufted, terminating the caudex branches, linear to narrowly linear-oblanceolate, 5–12 mm. long, 0.75–1.5 mm. wide, densely pubescent with appressed branched trichomes, these with a central axis and simple or forked branches on each side (doubly pectinate), ciliate with much larger, simple or rarely forked trichomes along the petiole margins; cauline leaves lacking; scapes 3–10 cm. long, slender, pubescent throughout with "doubly pectinate" trichomes; infructescence elongated, often occupying up to three-fourths of the scape-length; pedicels slender, divaricately ascending, straight to slightly curved upward, pubescent, 5–10 mm. long, expanded at summit; sepals tending to be persistent, sparsely pubescent, hyaline-margined, broadly oblong to elliptical, 2.5–3 mm. long, ca. 1.5 mm. wide; petals white, spatulate, 4–5 mm. long; filaments broad, markedly dilated below; siliques oblong, rounded above and tapered below, 5–8 mm. long, 2–3 mm. broad, flattened parallel to replum, pubescent on valve surfaces with appressed "doubly pectinate" trichomes, pubescent on the margins with forked or simple recurved trichomes; styles uniform in diameter from base to apex, 0.5–0.75 mm. long, stigma discoid, slightly greater in diameter than style; seeds 3–5 in each loculus, wingless, oblong, ca. 1.5 mm. long, 1 mm. wide.

Herba perennis caespitosa sobolifera; caulibus tenuibus erectis pubescentibus 3–10 cm. longis; foliis linearibus vel lineari-oblanceolatis dense pubescentibus 5–12 mm. longis, 0.75–1.5 mm. latis; pedicellis tenuibus divaricatis pubescentibus 5–10 mm. longis; petalis albis spathulatis 4–5 mm. longis; siliquis oblongis pubescentibus 5–8 mm. longis, 2–3 mm. latis; stylis 0.5–0.75 mm. longis; seminibus oblongis emarginatis ca. 1.5 mm. longis.

Type in the Gray Herbarium, collected on a rocky exposed slope in heavy clay soil, Clay Butte, one-half mile west of Beartooth Butte, northwestern Park County, Wyoming, August 1, 1951, *Reed C. Rollins & C. L. Porter 51269.* Other specimens seen: dry hillsides, vicinity of Flaming Gorge, Daggett Co., Utah, June 1, 1932, *L. Williams 476* (GH); same locality, 15 miles southeast of Manila, June 3, 1938, *Reed C. Rollins 2275* (GH).

The Utah specimens cited are very similar to the northern Wyoming material in most respects, but differ in having a slightly

coarser pubescence and siliques that are tapered both above and below.

The evidence that *D. oligosperma* and *D. pectinipila* hybridize would be used by some botanists as a basis for including both types within the same species. However, the fact that both maintain themselves in the area where they are in contact is very good evidence that there are genetic barriers of some kind preventing the formation of a single panmictic population. Furthermore, it seems to me that the existence of two populations separated by nearly four hundred miles, yet fitting neatly into the same morphological pattern, is evidence that we are dealing with an old and well established species, not populations of recent hybrid origin. The northeastern Utah-northwestern Wyoming jump may seem unusual, but this distribution is nearly paralleled by *Draba apiculata* and also by such an unusual crucifer in its Rocky Mountain distribution as *Parrya nudicaulis*, to mention only two examples from the Cruciferae alone. Of course it is quite possible that intermediate stations of *D. pectinipila* will be found as further explorations are carried out.

Draba incerta Payson. The five collections from the Beartooth Butte area, referable to this species, show an extremely wide range of variation. In fact, the limits equal or exceed that shown by the other forty specimens of *D. incerta* in the Gray Herbarium from the whole geographical range of the species. *Rollins & Porter 51276* was collected in the clay soil of rock crevices on a steep slope. The plants were loosely tufted, usually with numerous stems and with linear-lanceolate leaves. On the specimens collected, the siliques are narrow, elongated and pubescent. In contrast, the plants of *Porter 5904*, from near Island Lake in the same general area, have broad pods and much broader leaves. *Rollins & Porter 51271* is a glabrous fruited collection, the fruits being much the same size and shape of the type collection of *D. incerta*. While the plants of this collection were definitely caespitose, the tufts rarely exceeded 2 inches in diameter. However, plants of a mixed glabrous and pubescent fruited collection, *Rollins & Porter 51277*, grew in clumps up to six inches in diameter with numerous stems. The siliques of the latter are narrower and more elongated than most collections of *D. incerta*, being somewhat like no. 51276 in that respect. A col-

lection made in 1939 from Beartooth Butte, *Rollins & Muñoz 2843*, is similar to the type collection, and this includes the nature of the pubescence of the fruits.

In seeking for the basis of the rather wide quantitative and qualitative differences characterizing the collections mentioned, attempts were made to count the chromosomes in those collections where seed was available. Considerable favorable material of *Porter 5904* was obtained and, after hours of study of many figures, the number 2n = ca. 100 was arrived at.[1] Although an absolute count could not be established, it is at least known that high polyploidy is one of the contributing factors to the wide variation found.

Draba apiculata C. L. Hitchc. Plants of this species are caespitose, occurring in tufts up to two inches in diameter. The numerous scapes are relatively stout, as are the divaricate pedicels. It was collected in fruit as *Rollins & Porter 51272* on August 1, and later on August 17 picked up in flower by Porter (no. 5893) on the north end of Clay Butte. With Carlos Muñoz (no. 2839) I collected this species on Beartooth Butte in 1939. These collections are from the northernmost known stations for the species. As noted above, it ranges southward in the high mountains of western Wyoming to the Uinta Mountains of northeastern Utah. Our collecting sites on Clay and Beartooth Buttes are so close to the Montana border that *D. apiculata* is almost certain to be found in that state.

Draba Paysonii Macbride. Some of the plants of this species growing on a steep rocky slope were definitely woody at the base and most of them occurred in loose soil that showed evidence of seasonal shifting. The specimens taken have a very deep root system with an extensive and successively branched caudex. Collected on the south slope of one of the upper ridges, *Rollins & Porter 51275*.

Draba nivalis Lilj., var. **brevicula** Rollins, var. nov.

Perennial, caespitose, caudex usually branched; leaves tufted, terminating the caudex branches, broadly oblanceolate, obtuse, 4–10 mm. long, 1.5–2.5 mm. wide, only slightly narrowed to the petiole, midvein evident below, not detectable above, densely covered with dendritic trichomes, not pannose; ciliate along petiolar area; scapes 1 to 10, slender, pubescent

[1] I am indebted to Dr. L. O. Gaiser for making the two chromosome determinations reported in this paper.

below to sparsely so above, 2–6 cm. high; infructescence with 2 to 10 siliques often grouped toward the apex of the scape; pedicels ascending to divaricately ascending at an angle of ca. 45° from the rachis, glabrous, 0.5–2 mm. long, lower one or two pedicels with a leaf-like bract; bract entire, sessile, glabrous or with a few simple trichomes; sepals persistent, falling off only when fully matured siliques have been developed, white to yellowish white, oblong, ca. 1.5 mm. long, with a few long simple or forked trichomes on the back; petals white, spatulate, with a slender claw markedly emarginate, 2–3 mm. long; filaments dilated at base, whitish, anthers oval; siliques narrowly elliptical to ovate, glabrous, flattened parallel to septum, plain, not nerved, 4 to 8 mm. long, 1.5–2.5 mm. wide; style very short, less than 0.2 mm. long, stigma unexpandable; ovules 4–7 in each loculus.

Herba perennis; foliis oblanceolatis obtusis 4–10 mm. longis, 1.5–2.5 mm. latis; scapis tenuibus pubescentibus; pedicellis divaricatis 0.5–2 mm. longis; siliquis ellipticis vel ovatis glabris 4–8 mm. longis, 1.5–2.5 mm. latis.

Type in the Gray Herbarium, collected in crevices of vertical cliffs on the western edge of Clay Butte, August 2, 1951, *Reed C. Rollins & C. L. Porter 51278*. This same variety was collected on Beartooth Butte by *Louis O. Williams & Rua P. Williams 3649* in a mixture with *D. lonchocarpa* (GH).

Variety *brevicula* differs from *D. nivalis* proper in having short glabrous instead of much longer pubescent pedicels, broader siliques, fewer seeds and much larger basal leaves which lack the characteristic pannose pubescence of var. *nivalis*. Our plants are so different from the other Rocky Mountain varieties of *D. nivalis* that they at first appeared to represent a totally new species. However, once *D. nivalis* var. *elongata* was seen to represent a distinct species (*D. lonchocarpa*), as indicated below, it became easier to see the relationships. Variety *brevicula* appears to be closest to Newfoundland material of *D. nivalis*, but its relatedness to *D. nivalis*, var. *exigua* can also be seen.

Draba lonchocarpa Rydb. Two collections of this species were taken, one in the open (*Rollins & Porter, 51279*) and the other from the shady crevices of cliffs (*Rollins & Porter, 51280*). An additional collection from the north end of Clay Butte, *Porter 5883*, has a chromosome number of 2n = 16. Two collections from nearby Beartooth Butte are *Louis O. Williams & Rua P. Williams, 3649* in part (GH), and *Rollins & Muñoz, 2844* (GH).

For some time I have followed Dr. C. L. Hitchcock (1941) in treating this taxon as *D. nivalis* Lilj., var. *elongata* Wats. How-

ever, in studying the material of *D. nivalis*, I found that in addition to the other recognized characters that distinguish it from *D. lonchocarpa*, the funiculi are very short whereas in *D. lonchocarpa* the funiculi are very long and slender, equalling or exceeding the seeds in length. This is a fundamental difference that remains relatively constant and can be readily utilized to recognize even the shorter podded forms of *D. lonchocarpa*. I am convinced that these plants should be recognized on the species level. It is quite interesting that the long slender funiculus is also present in *D. nivalis*, var. *Thompsonii* as would be expected on other grounds. To bring the nomenclature into line, var. *Thompsonii* is transferred to *D. lonchocarpa* as follows:

Draba lonchocarpa Rydb., var. **Thompsonii** (C. L. Hitchc.) comb. nov. Based upon *D. nivalis* Lilj., var. *Thompsonii* C. L. Hitchcock, Univ. Wash. Publ. Biol. *11:* 85. 1941.

Draba aurea Vahl. Specimens were found on the grassy ridge-top of Clay Butte, *Rollins & Porter, 51260.*

Draba lanceolata Royle. Grassy ridge-top, Clay Butte, *Rollins & Porter, 51258.*

Draba crassifolia R. Graham. Hillside on bare soil of "snowdrift melt," *Rollins & Porter, 51261.* Also obtained on clay slopes near the north end of Clay Butte on August 17th, *Porter, 5890.*

Draba stenoloba Ledeb. Grassy ridge-top, Clay Butte, *Rollins & Porter, 51259.*

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MONTANA PLANT DISTRIBUTION RECORDS

W. E. Booth and J. C. Wright

New distribution records of the state flora in the Montana State College Herbarium have appeared during the past few years. It is interesting to note that about half of these new records were established from the examination of plants which were sent to the Herbarium for identification.

A recently adopted College policy directs that all plants sent to the College be sent to the Herbarium. The plants are processed at the Herbarium, and information regarding their identification is supplied the various specialists for their use in replying to the inquiries accompanying the plants. In former years, inquiries regarding plants were answered by the individuals who received them, but no permanent records were kept. Valuable records and much useful information has been compiled as a result of having all plants and questions regarding them referred to the Herbarium.

Among the new distribution records are these:

Agropyron triticeum Gaertn. Collected by J. C. Wright in Park County, Montana, Yellowstone National Park winter game range; present in crested wheatgrass meadow. June 23, 1952.

Another specimen was collected by George York from the same area July 8, 1952. The grass was mature at this time, and a small amount of seed was collected.

Artemisia longifolia Nutt. Collected by Karl Parker 30 miles southwest of Shelby, Toole County, Montana. 1952.

Another specimen was examined from Circle, McCone County, Montana in August 1951. The plant was submitted by L. P. Cade, but was not retained in the Herbarium as a specimen.

Aster frondosus (Nutt.) T.&G. Plants submitted as weeds from Ronan, Lake County, Montana. A sizeable patch in field. August 25, 1952.

Atriplex truncata (Torr.) Gray. Collected by W. E. Booth about 4 miles west of Red Rock Pass, southeastern Beaverhead County, Montana. Abundant locally in small denuded area; alkaline soil. August 21, 1952.

Bromus squarrosus L. Collected by George York about 4 miles west of Ashland, Rosebud County, Montana; open grass type; several plants. June 15, 1950.

Bromus trinii Desv. Collected by F. Markiniat on Moose Creek in the Gallatin Canyon, Gallatin County, Montana. This specimen was collected in 1927 and misnamed *B. squarrosus* L.

Calamagrostis scopulorum M. E. Jones. Collected by G. F. Payne near junction of Lightning and Taylor Fork creeks in Gallatin County, Montana. Eroded mountain slope at about 8500 feet altitude. Plant may possibly be valuable in revegetation of eroded mountain slopes. July, 1950.

Callitriche heterophylla Pursh. Collected by Richard H. Smith, in area 5 McCone County, Montana; R 49E T24N Sec. 26. Very common in the upper half of the reservoir and out to a depth of 2 feet. August, 1951.

Carex vallicola Dewey. Collected by W. E. Booth, identified by F. J. Hermann, Specimen Creek Campgrounds about 50 miles south of Bozeman, Gallatin County, Montana. Rocky, moist, grass-sedge type; July 5, 1952.

Centaurea diffusa Lam. Submitted as a weed specimen from Superior, Mineral County, Montana. Coming into area, growing along with *C. maculata* on hillsides and along roads. August, 1951.

A second specimen was collected by J. C. Wright in Sweetgrass County, Montana, 5 miles east of Park County line on Highway 10. Overgrazed pasture; gravelly loam; August 11, 1952.

Chorispora tenella DC. Plant submitted by M. T. Hedegaard, Extension County Agent, as a possible weed for identification. Lake County, Montana; August, 1951.

Plants were also submitted from Miles City, Custer County, Montana where they were thought to have originated from the planting of crested wheatgrass seed in 1950. Plants were examined that were collected on the fairgrounds at Great Falls, Cascade County, Montana, May 15, 1950.

Cirsium canescens Nutt. Collected by H. E. Morris and identified by X. M. Gaines of Washington State College. About one mile north of Huntley, Yellowstone County, Montana. Small patch along a fence row beside road. August, 1951.

Dianthus armeria L. Collected by J. C. Wright 5 miles west of Plains, Sanders County, Montana. Ponderosa pine forest; July 18, 1952.

Eupatorium maculatum L. Collected by H. E. Morris along Pryor Creek in Bighorn County, Montana. Moist creek bottom, fairly abundant locally in ditch. July 29, 1952.

Filago arvensis L. Collected by J. C. Wright 5 miles west of Plains, Sanders County, Montana. Overgrazed pasture. July 18, 1952. Additional specimens were received from W. W. Mauritson, County Agent from Kalispell, Montana. November 15, 1952.

Haplopappus multicaulis (Nutt.) Gray. Collected by W. E. Booth 20 miles north of Alzada, Carter County, Montana. Common and often abundant on rocky outcrops or in sandy areas in pasture where grass is sparse. July 19, 1948.

Haplopappus nanus (Nutt.) D. C. Eat. Collected by W. E. Booth near Red Rock Lake, Beaverhead County, Montana. Dry slope along south side of lake; sagebrush type; plant growing out of sterile rock outcrop. August 23, 1952.

Juniperus utahensis (Engelm.) Lemm. Collected by E. C. Moran along highway south from Bridger, Carbon County, Montana, lower hills of Pryor Mountains; January 16, 1953.

Matricaria maritima L. Submitted for identification by Kim Roberts, Extension County Agent, Thompson Falls, Sanders County, Montana. Growing under wide range of both soil and moisture conditions; common throughout County on abandoned fields and range land. September 8, 1952.

Sanguisorba occidentalis Nutt. Plants received for identification from C. W. Roath, Extension County Agent, Lake County, Montana. Idle land and roadsides; seems to be increasing. June 1948. Two specimens were submitted as weeds for identification since that time, July 6 and July 10, 1951 from Missoula and Mineral Counties.

Silene cserei Baumg. Collected by F. B. Cotner and W. E. Booth 2 miles west of Ingomar, Rosebud County, Montana. A few plants were found along road in moist soil. June 20, 1951.

Symphytum asperum Lepechin. Collected by John Hurst, Jr. at the home of Mrs. P. T. McCarthy, 521 Daly Avenue, Missoula, Montana. September 1, 1949.

Zizia aptera (Gray) Fern. Collected by W. E. Booth 15 miles north of Alzada, Carter County, Montana. Few plants in grassland. June 19, 1948.

THE DISCOVERY AND DESTRUCTION OF CALLICARPA AMERICANA IN MISSOURI

Julian A. Steyermark

The French Mulberry or Beauty-berry (*Callicarpa americana* L.), one of the most beautiful of native American shrubs, had never been found in a wild state in Missouri. E. J. Palmer, Bush, Letterman, Eggert, and Kellogg were well acquainted with it in Arkansas, where they had collected it from various localities, many of them near the Arkansas-Missouri border, but, although they looked for it in adjacent southern Missouri, none succeeded in locating a Missouri station. Reports of its occurrence in the state crept into the literature; for example, it was reported in Tracy's Catalogue of the Missouri plants in 1886 on p. 66 from Miller County as collected by Winick, but these reports proved to be based upon misidentifications. In Dr. Moldenke's Monograph of the genus *Callicarpa* (Rep. Sp. 39: 307. 1936), the Missouri records are likewise shown to be based upon unauthenticated reports.

At the New York Botanical Garden in the spring of 1949 I conferred with Dr. H. N. Moldenke about the distribution of the Verbenaceae in Missouri, and was surprised to learn that he had examined a specimen of *Callicarpa americana* supposedly collected in Chariton County, Missouri, by Mrs. Henry S. Young of the Carnegie Museum. She had collected the plant on June 30, 1925. My immediate reaction was that there must be some mistake, since Chariton County is in glaciated north-central territory and not the sort of terrain for *Callicarpa*. If it occurred anywhere in the state, it should have been found in extreme southern Missouri in an unglaciated section.

That same spring, I wrote Mrs. Young and expressed my interest in learning the exact station where she had collected the plant, at the same time questioning the possibility of a mistaken locality. I was gratified to hear from her as follows: "I am so sorry to cause all this trouble about the *Callicarpa americana*. I am normally a very careful worker and I had a large collection of Chariton Co., Mo., also of Logan Co., Ark. In working these over—with both places in my mind—I simply wrote the one state when it should have been the other. I take great pride in seldom making a mistake. But this was a bad one. So sorry!" As of the summer of 1949, then, *Callicarpa americana* was yet unknown to occur in a wild state in Missouri.

The writer for the past fifteen years has been making detailed plant surveys and collections of the flora from areas in Missouri that are in danger of being flooded by proposed impoundments of water. Some of these engineering projects are already completed and have done their destructive work—permanently flooding vast areas of woodland, meadow, and various habitats for plant life. Most of the completed dams have blotted out scenic landscapes along Ozark streams, drowning out the rare as well as the common species, and destroying many square miles of forested land. Part of the beautiful White River and its tributary, North Fork, has already been impounded by the Norfolk dam of Arkansas and Missouri. The rest of the White River and tributaries in Missouri is being destroyed by the Bull Shoals dam and Table Rock dam.

Although I had carried on extensive field work along the course of the White River for a number of years, there were yet many

uncompleted gaps which I wanted to survey before the dams did their permanent blotting out of the low lying vegetation. Thus, it was while botanizing on September 29, 1949, along a stretch of White River in Taney County by the Missouri-Arkansas line, just within Missouri territory, that I made a real discovery. From a place on the White River known as Brown's Ferry I was walking downstream north and east towards Cedar Hol along the rocky, limestone, wooded slopes that faced to the south into Arkansas. That afternoon I had not found anything especially exciting; then suddenly I spotted some clusters of small fruits of an unusual shade of purple (between a doge purple [color 732, p. 96 vol. 1. 1938] and beetroot purple [color 830/2, p. 173, vol. 2. 1939] according to the colour chart of the Royal Horticultural Society). Nearing the fruits and examining them, I recognized at once that they were indeed those of the long-hunted *Callicarpa.* Not one bush, but many were encountered in a small area on the wooded slopes from twenty to twenty-five feet above the surface of the river. Careful search revealed a rather frequent occurrence of the plant scattered up the rocky slopes to the lowest line of limestone bluffs, the highest point reached being 60 feet above the water level of the river.

I collected many duplicate specimens for distribution to various herbaria and was pleased to realize that here was a new northwestern limit of distribution for this shrub. At the same time, however, my pleasure in seeing this remarkably beautiful shrub was dispelled by the thought that it would not be long before these plants and the species, at the only known station in the state, would become exterminated. For, although the altitudinal distribution of *Callicarpa* was found as high as sixty feet above the present water level, the future impoundment of the Bull Shoals dam would not only completely cover this sixty feet, but fifty to sixty additional vertical feet. This would bring the level of the impounding waters well up on the high south-facing limestone bluffs that towered far above the last upper stand of *Callicarpa* bushes.

On May 5, 1951, I re-visited this spot and found the plants only after a difficult search, because the new stems were rising from the ground surface rather than growing out from the old wood. During the latter part of October the waters of Bull

Shoal dam began to rise on the White River and its various tributaries. Shore-lines were becoming permanently flooded. Trees and shrubs representing many species were being cleared along all the slopes from the old level of the streams to the upper new level of the impounded water and were being cut down ruthlessly and burned. An inferno of flames and smoke passed over the southwestern Ozarks, and with them the first and only stand of *Callicarpa* discovered in Missouri faded into oblivion.

The Missouri collection data is: *Steyermark 69453,* rather frequent on south-facing slopes from base to lowest line of bluffs about 60 feet above water level, along north and west side of White River, north and east of Brown Ferry, downstream to Cedar Hol, T 21 N. R 16 W, sect. 13, 5½–6 mi. southeast of Protem, Taney Co., September 29, 1949. Specimens have been deposited in the Chicago Natural History Museum Herbarium, Gray Herbarium, Missouri Botanical Garden Herbarium, New York Botanical Garden Herbarium, United States National Herbarium, and several other herbaria.—CHICAGO NATURAL HISTORY MUSEUM AND MISSOURI BOTANICAL GARDEN.

TYPIFICATION OF EUPHORBIA MACULATA L.—In two articles (RHODORA **48:** 197–200, 1946; Bull. Torr. Bot. Cl. **74:** 332–333, 1947) I defended the application of the name *Euphorbia maculata* L. to the upright plant of eastern North America long known as *E. preslii* and *E. nutans.*

I did this, not because of any bias in favor of this usage or its author, nor against the previous application to the prostrate plant now called *E. supina* Raf. by Wheeler and Fernald. Neither did I have any bias against Svenson or Croizat, upholders of the older usage. It was, rather, a protest against the specious arguments used in the matter (Svenson, RHODORA **47:** 273–302, 363–388, 1945; Croizat, Bull. Torr. Bot. Cl. **74:** 153–155, 1947) and because the facts known to me seemed to support Wheeler's conclusions.

Although the arguments referred to above still appear to me as unsound as ever, an opportunity, in 1950, to study the specimens in the Linnean Herbarium has led me to re-examine the question. From a conversation with J. E. Dandy and from a

copy, kindly made available by him, of a manuscript "Note on the typification of *Euphorbia maculata* L." by him and E. Milne-Redhead, it is apparent that they are inclined to uphold the previous usage and to reject that of Wheeler. This is on the grounds that Linnaeus erred in writing the name "*maculata*" on the specimen in the Linnean Herbarium which is considered by Wheeler to be the type of *Euphorbia maculata* L.

Examination of the evidence now available to me suggests that the name "*maculata*" on the sheet of the Linnean *Euphorbia* numbered "17" may indeed be an error, as the number "17" applied to *Euphorbia hypericifolia* L. in the Species Plantarum, while number "21" is that of *E. maculata* L. Number "21" appears in the herbarium on an unnamed sheet of the prostrate plant now called *E. supina* Raf. (annotated by J. E. Smith "*maculata*").

The treatment of *E. maculata* in Species Plantarum seems to be based both on a specimen and on the Plukenet plate (Alm. t. 65, f. 8). Since I have already shown (Rhodora **48:** 197–200, 1946) that this plate is the erect plant rather than the prostrate one, the possibility of two species being involved in the basis of *E. maculata* L. suggested by both Svenson and Croizat, and admitted in my second paper, seems to be borne out. In such a case, subsequent typifications must be examined. This has been done by Croizat (loc. cit.) and myself (1947). There seems no doubt that Linnaeus did, in the Mantissa (**2:** 392, 1771), subsequently select the upright plant when he said "*Euphorbia maculata* similis *E. hypericifoliae*," thus effectively typifying the species.

It only remains to see if this typification is in accord with the "Guide for the determination of types" adopted at Stockholm in 1950. In this, provision 4a says, in part, "In choosing a lectotype any indication of intent by the author of a name should be given preference unless it is contrary to his description and remarks." Linnaeus, in the Mantissa, certainly indicated his intent to apply the name to the erect plant. In my judgment, the description accompanying the original publication of *E. maculata* L. (Sp. Pl. 455, 1753) could apply to either species, with the lack of any mention of a prostrate habit and the "calyce rufe" favoring the erect plant. Therefore the typification in

the Mantissa seems to be in accord with this guide and there is no reason for rejecting it.

Thus, even though the plant indicated as type by Wheeler is probably not the type, his applications of the names *Euphorbia maculata* L. to the common upright plant and *Euphorbia supina* Raf. to the prostrate one seem to hold.—F. R. FOSBERG, FALLS CHURCH, VIRGINIA.

ALLIUM TRICOCCUM AIT., var. **Burdickii,** var. nov.—Folia sine petiolis 14–19 cm. longa, 0.8–2 cm. lata, lanceolata; vaginae albae; petioli viridicantes; scapi 13–16 cm. longi.

Allium tricoccum Ait. is larger in all respects than the variety. Leaves without petioles are 15.5–23 cm. long and 2.6–6 cm. wide. The scape varies from 21 cm. to 33.5 cm. in length. Both sheaths and petioles are red or reddish instead of white or greenish. In outline the leaves are elliptic not lanceolate as in the variety. The species is found generally in marshy habitats whereas the variety prefers upland woods. If both grow in the same locality the variety occupies the higher ground. Another factor that separates the two is their differential development. The species appears at least a week earlier in the spring than the variety but in spite of this earlier start it comes into bloom more than a week later than the variety.[1] [2]

In Kalamazoo County the species is abundant in Section 20, Prairie Ronde Township, where it occurs with swamp birch, tamarack, white elm and red ash. Also it is found in moist soil in Brady and Climax Townships and in several places along the Kalamazoo River. Variety *Burdickii* grows principally in upland woods of beech and maple on the western side of the county. It has been recorded from sections 4, 5, 16, 19, 22, 24, 26 and 30 of Prairie Ronde Township and in section 18 of Schoolcraft Township. Collections have been made in Porter Township, Van Buren County and near Libertyville, Lake County, Illinois.

This variety has been named in honor of Dr. J. H. Burdick, who collected specimens in 1877 at Milton, Wisconsin and who

[1] Hanes, Clarence R. and Ownbey, Marion. "Some observations on two ecological races of Allium tricoccum in Kalamazoo County, Michigan." Rhodora: 48: 61–63. 1946.

[2] Hanes, Clarence R. and Florence N. Flora of Kalamazoo County, Michigan. 68–69. 1947.

sent them to the Gray Herbarium with descriptions showing the differences that have been noted above.—Clarence R. Hanes, Schoolcraft, Michigan.

Iris Pseudacorus L. Established in the Vicinity of London, Ontario.—On June 14, 1952 the writer located a stand of the yellow iris, *Iris Pseudacorus* L. in Delaware Township, Middlesex County, Ontario on the south bank of the Thames River, twelve miles downstream from the union of the north and south branches of the Thames in London. The plants occupied the area surrounding the east end of a small pond about 350 yards east of the bridge which crosses the Thames on the road between the villages of Delaware and Komoka. The pond is on a bluff forming the bank of the river and remains filled with water during the summer, being fed from drainage from the slopes above and having an outlet directly into the river. The plants were concentrated in an area of 30 yards by 40 yards in the marshy region at the edge of the pond, some with their rootstocks in soil covered by six inches of water and some in adjacent damp ground. On June 17 the pond was again visited and eleven separate plants were counted, the smallest having leaves two feet tall, with one flower in bud and another in bloom, and the largest having leaves and stems five feet tall, with sixty-seven flowers in bloom, several flowers faded and a few in bud, the whole plant being five feet in diameter. A few plants of the Blue Flag, *Iris versicolor* L. were also present along the border of the pond. Collections of *Iris Pseudacorus* were made and six herbarium sheets were prepared: 526 a, b, c (14.VI.52) and 527 a, b, c (17.VI.52). Of these 526 a and b are deposited in the Gray Herbarium, the specimens having been kindly identified by Dr. R. C. Foster, and the other four sheets are in the writer's collection.—W. W. Judd, Department of Zoology, University of Western Ontario, London, Canada.

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SOME PLANTS OF MOUNT McKINLEY NATIONAL PARK, McGONAGALL MOUNTAIN AREA

Winslow R. Briggs

During a Harvard Mountaineering Club expedition into the Alaska Range during the summer of 1952, Thayer Scudder and the author were able to make the collection of plants considered in this paper. Botanizing had to be interspersed with a program of surveying, testing of equipment and various other activities. However, it was possible to collect at various times over a period of 26 days which represents half of the very brief growing season characteristic of relatively high altitudes in the Alaska Range.

An attempt was made to collect, as thoroughly as possible, the vascular plants at three different altitudes on McGonagall Mountain, which is one of the foothills to the north of Mt. McKinley and just north of the Muldrow Glacier. The first collecting locality was in the valley of Cache Creek from the junction of Cache and Oastler Creeks, at an altitude of 3750 feet, to the point at which the Cache Creek valley closes in to become a canyon, at an altitude of 4350 feet; plants were collected here on June 29th (nos. 1–14), July 25th (nos. 57–65) and July 26th (nos. 70–96). The second locality was at McGonagall Pass, at the head of the Cache Creek valley, and overlooking the Muldrow Glacier, at an altitude of 5700 feet; plants were collected here on July 4th (nos. 15–46), July 17th (nos. 47 and 50–56) and July 26th (nos. 200–205c). The third locality was on or near the summit ridge of McGonagall Mountain, at an altitude of 6550 feet; plants were collected here on July 26th (nos. 206–219). The last mentioned collection came from the highest altitude at which vegetation was seen during the trip, with the exception of scattered rare plants of *Saxifraga oppositifolia* seen above 7000

feet on Mt. Brooks, seven miles southeast and across the Muldrow Glacier. All three collecting areas were well above timberline, which is at about 2900 feet. Collections were also made on July 17 (nos. 48 and 49) and July 20 (nos. 66–69) of the few plants which were found on the barren lateral moraine at the base of Mt. Brooks.

McGonagall Mountain is a portion of a granitic batholith 2 to 4 miles wide and about 20 miles long with its long axis oriented on an east–west line (Bradford Washburn, 1953).[1] It is bordered by the Muldrow Glacier which parallels it on the south. Across the Muldrow are the major peaks of the McKinley batholith itself, plus Mt. Brooks, Mt. Wedge, Mt. Mather and others. The bedrock of McGonagall Mountain is a granodiorite, and is thought to be of late Jurassic age. The entire region was heavily glaciated in relatively recent times, as is shown by the presence of two large terminal moraines at the mouth of the Cache Creek valley. Furthermore, the surface of the Muldrow Glacier is only 50 feet below McGonagall Pass, and it undoubtedly spilled over the pass and down into the valley during the Pleistocene, and probably more recently.

Frost action is severe at all three localities, as is well shown by the presence of sorted circles and terracettes, particularly at the pass, and larger solifluction forms on the valley slopes and meadows. Sorted circles are the result of freezing and thawing on level ground, while terracettes plus larger solifluction phenomena result from the mass movement of soil materials down slopes as a result of freezing and thawing, with an accumulation of coarser gravel and boulders on the lower margins of the sagging areas in many cases (A. L. Washburn, 1950). Rainfall data are not available, but the total precipitation must be fairly high. During the group's stay in the area, rain fell on 27 out of 35 days, and snow fell on one occasion.

On McGonagall summit, the soil is extremely gravelly, with virtually no accumulation of humus. Snow, rain and ground frost melt-water keep the ground saturated most of the time. Only 14 species of vascular plants were found capable of surviving the extremes of temperature and exposure to wind occurring at that altitude. The actual summit ridge was bare of all vegeta-

[1] Oral communication.

tion, and what plants were found grew in the little shelter offered by the boulders on the slopes below the ridge. Individual plants were widely scattered, and from a distance there appeared to be no vegetation at all. Five of the 14 species are ones with a campion or pincushion habit, and one, *Saussurea viscida*, normally over a foot in height, was reduced to a few inches. Of the species collected, one, *Saussurea viscida*, was not found below the summit; three, *Polemonium boreale*, *Saxifraga oppositifolia* and *Saxifraga serpyllifolia* were found in the pass, but not in the valley; and the remaining ten were found in the valley and the pass (with the exception of *Campanula lasiocarpa*, which was collected in the valley, but not in the pass).

At the pass, there was a greater accumulation of fine gravel than on the summit, and on the surface of the terracettes on either side of the pass, thin patches of humus sometimes accumulated. As on the summit, the commonest species were those with a campion habit, and individual plants were widely scattered. Most of the area was bare gravel strewn with boulders, but on July 17, it resembled a well kept rock garden. On the surface of the terracettes, *Draba densifolia, Polemonium boreale* and *Synthyris borealis* were common, and on the more level gravel, *Saxifraga oppositifolia, Saxifraga lyallii, Saxifraga serpyllifolia* and *Silene acaulis* were prominent. *Papaver radicatum* was slightly less common. In the wettest gravel were found *Smelowskia borealis* var. *Koliana, Minuartia macrocarpa* and *Luzula confusa.* Forty-two species, 25 of which were not found in the valley below, were collected.

A much greater diversity of habitat types existed in the valley. In the creek bed, most of which is exposed except during the earliest part of the growing season, the gravel was largely bare. However, patches of *Arnica louiseana, Luzula confusa* and *Epilobium latifolium* were prominent on small humus covered areas. On either side of the creek were broad sloping meadows on which there was an uneven layer of humus and *Sphagnum* which reached a foot in thickness in some places. As on the summit and at the pass, the subsoil was kept saturated with moisture most of the time, but on slopes with good drainage, the surface layer could become fairly dry. Except where occasional boulders protruded, the vegetation cover was complete. In localized areas on the

order of a few square yards in size, the vascular plant cover often consisted of a single species only. Plants which normally occurred in such patches were *Cassiope tetragona*, *Loiseleuria procumbens*, *Anemone narcissiflora*, *Geum rossii* and *Dryas octopetala*. Among the cobbles in the habitats at the lower margins of the solifluction forms where there is a lot of moisture, but little fine grained material and frost heaving, were found almost exclusively *Therefon richardsonii* and to a lesser extent *Minuartia macrocarpa*. The former is a tall herb with large dark green leaves which make it prominent and enable one to identify the lower margins of the frost formations mentioned above from over a half-mile away. In very wet depressions where drainage was poor, *Sedum rosea*, *Claytonia sarmentosa*, *Polygonum bistorta*, subsp. *plumosum* and *Therefon richardsonii* were important elements. Species with a campion habit were relatively rare, and occurred primarily in disturbed situations such as the banks of gullies where little humus could accumulate. Of the campion plants found at the pass, only *Silene acaulis* and *Minuartia macrocarpa* occurred in the valley, but *Loiseleuria procumbens*, not found in the pass, also showed this habit. Of the 47 species collected in the valley, 31 were not found in the pass or above.

In the following list of vascular plants, the letter S after a species-name indicates that it was collected on the summit of McGonagall Mountain; the letter P, in the pass; the letter V, in the valley; and the letter M, on the lateral moraines below Mt. Brooks.

List of Vascular Plants

Hierochloë alpina (Sw.) Roem. and Schult., V, no. 91, dry meadows and slopes; P, no. 28.

Arctagrostis latifolia (R.Br.) Griseb., V, no. 89, exposed gravel of stream bed, uncommon.

Trisetum spicatum (L.) Richt., V, no. 86; P, no. 204, wet gravel.

Poa arctica R. Br. V, no. 96; P, no. 205a; S, no. 218; very wet gravel. New to Alaska Range.

Poa glauca Vahl, P, no. 205b.

Festuca altaica Trin. V, no. 61.

Carex microchaeta Holm, V, no. 85; P, no. 27; S, no. 211; common in drier gravel where humus is absent.

Porsild's treatment (1951) is followed in placing these specimens under *C. microchaeta* Holm. The culms are phyllopodic, by which character the material is distinguished from *C. podocarpa* R. Br., in which the culms

are aphyllopodic. If one chooses to recognize *C. nesophila* Holm as a species distinct from *C. microchaeta*, the material clearly belongs to the latter species, lacking fibrillose leaves along the rhizome, and possessing strongly exserted styles. The presence or absence of teeth on the mouth of the beak of the perigynium is not a good character, since a full range of variation may be found on a single plant. See Porsild's paper for a fuller discussion of the above species.

Luzula confusa Lindb., V, no. 83; P, no. 39; S, no. 210; dry gravel, very common at all three altitudes.

Tofieldia coccinea Rich., V, no. 95, dry meadow where humus was thin.

Lloydia serotina (L.) Reichenb., V, no. 12; P, no. 15; dry meadows and terracettes.

Salix alexensis Cov., V, no. 58, gravel of stream bed. This collection was taken at the highest altitude at which a shrubby willow was observed.

Salix arctica Pallas, V, no. 6, sloping meadows.

This material ressembles *S. arctica* Pallas, with the exceptions that it has styles over 2 mm. long, and occasional although very reduced stipules. These two characters are suggestive of *S. crassijulis* Trautv., a species from south of the Alaska Range, the Bering Sea Coast, and the Aleutian Islands. I am in agreement with Hultén that these two species and *S. torulosa* Trautv. are very possibly subspecies of the same species.

Salix phlebophylla Anderss., P, no. 43b.

Salix reticulata L., P, no. 205c.

Salix rotundifolia Trautv., P, nos. 41 and 43a.

No. 41 represents typical *S. rotundifolia* as it occurs in the area. No. 43a, although having the short catkins and glabrous capsules of *S. rotundifolia*, has the larger and more ovate leaves of *S. phlebophylla*. No. 43b, furthermore, has leaves which closely match those of 43a, but its catkins are longer and its capsules are pubescent in many cases; it resembles *S. phlebophylla*, but with a slight variation in the direction of *S. rotundifolia*. It seems possible, on the basis of these facts, that a certain amount of introgression has taken place between these two species, particularly since all three collections were made from McGonagall Pass, from fairly fine gravel, within an area of about 100 square feet.

Oxyria digyna (L.) Hill, V, no. 57, wet gravel of stream bed.

Polygonum bistorta L., subsp. plumosum (Small) Hult., V, no. 65, wet depressions.

Polygonum viviparum L., V, no. 79, wet meadows, on thin humus.

Claytonia sarmentosa C. A. Mey., V, no. 72, margins of wet depressions.

Claytonia scammaniana Hult., P, no. 26.

Stellaria crassifolia Ehrh., V, no. 73, wet meadows.

Stellaria longipes Goldie, var. edwardsii Kurtz., P, no. 19.

Minuartia macrocarpa (Pursh) Ostenf., V, no. 87; P, no. 21; S, no. 216; wet gravel, scree slopes, and lower margins of solifluction formations.

Silene acaulis L., V, nos. 7 and 90; P, no. 6; S, no. 215; moist meadows and terracettes.

Melandrium furcatum (Raf.) Hult., M, no. 67.

Anemone narcissiflora L., subsp. interior Hult., V, no. 92, dry sloping meadows.

Ranunculus nivalis L., M, nos. 49 and 66.

Papaver radicatum Rottb., V, no. 5; P, no. 20; S, no. 213; dry hillsides and gravel, commoner at higher altitudes.

Cardamine bellidifolia L., P, nos. 44 and 52.

Draba alpina L., V, no. 4; P, nos. 46 and 47; dry gravel and moraine.

Draba densifolia Nutt., P, no. 17, surface of terracettes, on slight accumulation of humus.

Draba eschscholtzii Pohle, P, nos. 23b, 38 and 51b.

Draba nivalis Lilj., P, no. 51a.

Draba pseudopilosa Pohle, P, nos. 23a, and 51c.

The genus *Draba* is very poorly understood in the arctic, and determinations can at best be considered a temporary assignment of names awaiting an exhaustive study of the group. In the material from McGonagall pass, 23a and 51c appear most closely related to *D. pseudopilosa*, a species restricted to northeast Asia, one station on the Bering Sea, and two along the arctic coast of Alaska. These plants have the dense branched pubescence of *D. nivalis*, mixed with simple hairs. The midribs of the leaves, although persistent on the old leaf bases, are not at all prominent on the leaves themselves, a character in which these plants differ conspicuously from *D. nivalis*. The pedicels are pubescent with branched and simple hairs, the siliques are narrower toward the tips, than at the bases, and the styles are very short (less than 0.25 mm. long). The petals are cream colored, and the scapes are long and flexuous. This population is essentially homogeneous. No. 51a matches *D. nivalis*, being fairly typical material, with fine stellate pubescence, reduced styles, and white petals. Nos. 23b, 38, and 51b match Scamman no. 625g from McKinley Park, a plant considered by Hultén to belong closest to *D. eschscholtzii*, which has its type locality in Asia, on the Chukch Peninsula, and has been collected from three widely separated stations along the Yukon River valley. They differ from *D. pseudopilosa* in their emarginate petals; thinner pubescence, of a more strigose character; shorter and stiffly erect scapes; and prominent styles, which are 1 mm. or more in length. All of the above material is separated from the *D. fladnizensis*—*D. lactea* complex by the possession of pubescent scapes and pedicels. All three species occurred in fine wet gravel. *D. pseudopilosa* and *D. eschscholtzii* are both new to McKinley Park.

Smelowskia borealis (Greene) Drury and Rollins, var. koliana (Gombocz) Drury and Rollins, P, nos. 22 and 50; extremely wet gravel. These plants are in flower with a few scattered fruits. Their villosity and leaf shape approaches that of var. *villosa*, but flowering material of all varieties is conspicuously more villous than fruiting material. The more mature fruits of these collections are closest to those of var. *koliana*. These plants were collected near the type locality of var. *koliana* and from a site where material clearly belonging to that variety has been collected (Herning, Nelson 1939).

SEDUM ROSEA (L.) Scop., V, no. 75; P, no. 40; S, no. 217; moist depressions and wet gravel.

THEREFON RICHARDSONII (Hook.) O. Kze., V, no. 70; almost always on the lower banks of solifluction formations, among the coarser gravel and boulders.

SAXIFRAGA BRONCHIALIS L., subsp. FUNSTONII (Small) Hult., V, no. 62; P, no. 56; wet gravel and scree slopes.

SAXIFRAGA CAESPITOSA L., subsp. SILENIFLORA (Sternb.) Hult., M, no. 68.

SAXIFRAGA ESCHSCHOLTZII Sternb., P, no. 32.

SAXIFRAGA FLAGELLARIS Willd., P, no. 45, moist gravel.

SAXIFRAGA LYALLII Eng., V, no. 1; P, no. 42; S, no. 219; stream banks and scree slopes.

SAXIFRAGA OPPOSITIFOLIA L., P, no. 34; S, no. 209; wet gravel, common.

SAXIFRAGA RIVULARIS L., M, no. 69, new to McKinley Park.

SAXIFRAGA SERPYLLIFOLIA Pursh, P, no. 25; S, no. 208; wet gravel, common.

CHRYSOSPLENIUM WRIGHTII Franch. and Sauv., V, no. 2; P, no. 30; moist depressions.

PARNASSIA KOTZEBUEI Cham. and Schlecht., V, no. 74; wet meadow.

GEUM ROSSII (R. Br.) Ser., V, nos. 8 and 88; dry meadows, common.

DRYAS OCTOPETALA L., V, no. 9; dry meadows, common.

OXYTROPIS NIGRESCENS (Pall.) Fisch., subsp. PYGMAEA (Pall.) Hult., P, no. 24; moist gravel.

EPILOBIUM LATIFOLIUM L., V, no. 60; P, no. 202; stream bed, and dry gravel.

LIGUSTICUM MUTELLINOIDES (Crantz) Villar, subsp. ALPINUM (Ledeb.) Thellung, V, no. 94; P, nos. 31 and 53; dry tundra, surface of terracettes.

PYROLA GRANDIFLORA Rad., V, no. 81, dry meadow.

LEDUM PALUSTRE L., subsp. DECUMBENS (Ait.) Hult., V, no. 93, dry slope.

LOISELEURIA PROCUMBENS (L.) Desv., V, no. 15, dry meadow.

CASSIOPE TETRAGONA (L.) D. Don, V, no. 14, dry meadows, very common.

VACCINIUM VITIS-IDAEA L., subsp. MINUS (Lodd.) Hult., V, no. 82, dry meadows.

DIAPENSIA LAPPONICA L., subsp. OBOVATA (F. Schmidt) Hult., V, no. 10, dry meadows.

ANDROSACE CHAMAEJASME Host., subsp. LEHMANNIANA (Spreng.) Hult., P, nos. 37 and 54, wet gravel and scree slope.

DODECATHEON FRIGIDUM Cham. and Schlecht., V, no. 71, stream banks and moist slopes.

GENTIANA GLAUCA Pall., V, no. 93, dry meadows.

POLEMONIUM BOREALE Adams, P, no. 18; S, no. 212; dry slopes and terracettes.

SYNTHYRIS BOREALIS Pennell, V, nos. 3 and 11; P, no. 29; S, no. 207.

CASTILLEJA PALLIDA (L.) Kunth, subsp. MEXIAE Pennell, V, no. 76, dry meadows.

PEDICULARIS CAPITATA Adams, V, no. 78, dry meadows.

Pedicularis lanata Cham. and Schlecht., P, nos. 16 and 55.

Pedicularis verticillata L., V, no. 80, wet meadows and depressions.

Campanula lasiocarpa Cham., V, no. 77; S, no. 214; dry meadows and gravel, uncommon.

Erigeron eriocephalus J. Vahl, M, no. 48.

Erigeron purpuratus Greene, P, no. 201.

Antennaria monocephala DC., P, no. 35.

Antennaria philonipha A. E. Pors., V, no. 64, dry meadows, on thin humus.

Artemisia arctica Less., V, no. 84, wet gravel and thin humus.

Arnica louiseana Farr., subsp. frigida (Meyer) Maguire, V, no. 59, common, on stream bed gravel, on thin patches of humus.

Saussurea viscida Hult., var. yukonensis (Pors.) Hult., S, no. 206.

Senecio atropurpureus (Ledeb.) B. Fedtsch., var. tomentosus (Kjellm.) Hult., P, no. 200, wet gravel.

Taraxacum kamtchaticum Dahlst., P, no. 33, uncommon.

Crepis nana Rich., P, no. 203.

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CHROMOSOME STUDIES IN KUHNIINAE (EUPATORIEAE). I. BRICKELLIA[1]

L. O. Gaiser

Introduction

Among the many outstanding contributions to the taxonomy of the *Compositae* by Robinson, the monograph (1917) on *Brickellia* clearly presents that author's interpretation of the genus. The excellent drawings of portions of inflorescences with leaves, especially indicate the attention given to specific and varietal characters of the head, achene, florets, and phyllaries. He included ninety-one species, eighty of them considered unquestionably distinct. In the introduction he expressed his difficulty in making any division of the genus into true subgenera. To him it was best divided into nine sections of closely related species. Admittedly, these were separated sometimes by rather artificial boundaries. The sections are of very varied size, seven consisting of one, two or three species while one, *Bulbostylis*, contains seventy-seven species in nine subsections. It should be pointed out that as the genus occurs mostly in the less accessible mountain ravines and deserts of Mexico, there were at that time not a great many herbarium specimens, some species being represented by one or at most a few collections. This fact contributed to the placement of some in the doubtful category.

This painstaking treatment of a genus presented a challenge for a cytological inquiry of the chromosome numbers of the species covered. Besides, Robinson (1913) had also presented a key to the subdivision *Eupatorieae* of the *Compositae* in which *Brickellia* is found in the small subtribe *Kuhniineae.* This consists of nine mostly small genera, of which *Brickellia* has the largest number of species and *Liatris* is second with approximately thirty-two species (Gaiser, 1946). Since I have previously reported on chromosome numbers in *Liatris* (Gaiser, 1949, 1950 a and b), an American genus chiefly of United States and Canada, it was of considerable interest to examine a larger closely related genus having a more southerly geographic dis-

[1] The author is grateful to Dr. P. C. Mangelsdorf and Dr. R. C. Rollins for valued criticism of this manuscript.

tribution. *Brickellia* occurs from the northern boundary of United States in Washington, southward through the western states (with one species in the east) through Mexico and Central America and perhaps sparingly in eastern Brazil, but it is especially abundant in Mexico.

The general features of the genus *Brickellia* are well presented by Robinson and through the sections one follows from small heads of eight, to the largest, of over one-hundred florets. The species are chiefly calciphiles, xerophytic in varying degree and occurring mostly in mountain ravines with some limited to deserts. It may be emphasized here that in comparison with a perennial herbaceous genus such as *Liatris, Brickellia* consists about equally of shrubs and perennial herbs, with intermediate types, and includes at least one annual. The general shrub-like nature of many species of western United States stimulated an inquiry regarding the nature of those of the more southern countries. Are species of Mexico and Central America more woody? If so how do the chromosome numbers[2] of woody *Compositae* compare with those of closely related herbaceous ones? If there are varying chromosome numbers in the genus, are the more basic numbers found in species of the tropics?

The cytological studies have put particular emphasis on comparisons of the karyotypes of the various species, believing that if karyology is neglected, one of the soundest indicators of the major trends of evolution may be missed. In conjunction with the chromosomal variations an attempt was made to see if any correlations could be found which might be of further aid in taxonomic classification. This included microscopic examination of the various parts of the plant: the trichomes, secretory glands, the so-called punctate condition of the leaves; and the barbules of the pappus.

Methods

In Guatemala, during the last two weeks of September, 1950, it was found that *Brickellia adenocarpa* Robinson, the species apparently common in the Departments of Sacatapequez and

[2] The author most gratefully acknowledges the primary aid of a grant from the American Philosophical Society for this project which made possible a trip to Guatemala and Mexico for the collection of cytological materials in the field. I wish to acknowledge also a subsequent grant from the American Academy of Arts and Sciences received for assistance in getting timely attention for the material brought back, such as germinating seeds at once before they became inviable, etc.

Guatemala, had not begun to flower in some stations and in others it was just beginning to do so. With many more species occurring in Mexico than Guatemala, I proceeded there and in the six-week period spent in the plateau states of Mexico, Oaxaca, Michoacán (around Morélia), Jalisco (Guadalajara and Rio Blanco), Guerrero (Taxco), Morelos (Cuernavaca and Yautepec), Puebla (Izucar de Matamoros) and on a trip to Vera Cruz via Orizaba and returning via Jalapa, more than a dozen species and several varieties were obtained in satisfactory stages for meiotic study. Of at least as many more it was possible to collect seeds. A few of the species were only encountered once. However, in most of them it was possible to make comparisons through collections from several stations. Seeds of four other species were obtained a year later from people with whom contacts had been made.

Collection of cytological material of this genus in Mexico was fortunately greatly helped by taking along a plastic bag referred to by Stevens (1949). Since the cytologist must collect and press specimens as adequate reference- and identification-material, as well as fix the flowering material wherever it is found it is usually necessary to take along into the field a kit of fixing materials. From the earliest trips made, it was learned that branches of these shrubby plants, which had been carried in a plastic, zipper-closed, pillow-case throughout the morning and into the afternoon collecting period, had not wilted upon return to quarters. Transpiration vapor collected on the inside of the slightly inflated case and the leaves and heads seemed as though freshly cut. Upon removal of the involucre, the florets of young heads which were considered to be of the proper age for meiotic stages, seemed equally fresh and suitable for fixation. Thus this procedure was almost entirely depended upon for the reason that it gave greater convenience in the adequate selection and handling of the materials, and also because it left more time for actual collection when in the field. Perhaps delicate annual plants could not have been handled thus but this method might ease the cytologists' problems with at least the more xerophytic types.

The fixative used was that of Karpechenko as used by Langlet (1932) and as previously employed for studies of *Liatris*. It had

been found to be a good fixative as well as an expedient one since materials had been left in it unharmed during the busy summer season and then were examined later. The flowering material of the native shrubs collected in Mexico in the Autumn were examined in the Winter and Spring months in the laboratory. There was no evidence of shrinkage or mal-fixation, at least no greater incidence than exists in the fixations of a normal project with the plants to be studied in the greenhouse or experimental plot. Evidence of the clarity of figures obtained can be seen in photomicrographs of figures 50 to 60.

Of the species which were already fruiting, the seed collected was germinated as soon as possible upon return so as not to miss their periods of viability. The root-tips obtained were examined variously. Some comparisons were made following the ordinary smear technique with aceto-carmine stain and also Feulgen's (Meyer, 1943). Meyer's (1945) paradichlorobenzene technique was also tested and proved to give as claimed, shortening of the mitotic chromosomes (see fig. 35). Results from aceto-carmine smears were not often good, probably due to the secretory inclusions, which often caused a darkening of the cytoplasm unsatisfactory for photomicrography. Whenever seedlings were obtained and grown in the greenhouse, root-tips from these were fixed, stained *in toto*, in Feulgen's and afterwards embedded through a rapid alcohol-chloroform-paraffin technique. Others were fixed in Karpechenko's and Belling's followed by Newton Gentian Violet stain. As the latter method had been employed for the study of the earliest received species in 1948, it formed a basis for general comparison of chromosome morphology of species within this genus as well as with those of the other related genera of the *Kuhniineae*. Of any recent herbarium specimens[3] received, seeds were always tested and of course, packets of seeds gave abundant material. Seeds of species from western United States were usually found inviable if more than two years old. Occasional exceptions were found as in a few each of *Brickellia Coulteri* Gray, *B. megaphylla* Jones and *B. macromera* Robinson from Baja California. However, the seeds collected

[3] The author wishes to express gratitude to all who have contributed any specimens, all of which grow in less readily accessible places. Especially am I indebted to Mr. A. G. Johnson for collecting in the Durango-Chihuahua region of Mexico and the Chiricahua Mts. of southwestern Arizona while on a return trip from Mexico City.

in southern Mexico and also in samples received from Costa Rica (*B. argyrolepis* Robinson) and Honduras (*B. adenocarpa*), proved noticeably less viable within five months. One remarkable exception was found in the only annual species studied, *B. diffusa* (Vahl) Gray. The minute seeds of the one accession which germinated had been collected more than five years previously.

For the examination of trichomes and glands, leaves from herbarium specimens were cleared in approximately twenty percent sodium hydroxide for varying lengths of time according to their thickness and then dehydrated and mounted in diaphane. The more delicate leaves of seedling plants were preferably cleared in lactic acid and similarly mounted. Preparations of pappus required heating in water to drive out the air bubbles before mounting in lactic acid.

Material

In table I are given the names of species which it has been possible to examine so far, as well as the name of the collector, the number, time and place of collection of each accession.[4] They have been arranged according to the sections given by Robinson, with inclusion of the number (in brackets) of species belonging to each section or subsection and their general habit of growth.

One species, *B. diffusa,* of the only possible two annuals that make up Section I, had been collected from two stations in Mexico but none of these seeds proved to be mature. It was most gratifying therefore that in a chance trial of seeds of the most recent collection available in the Gray Herbarium, one of 1946 from Panama, a few proved to be viable. The lack of any representatives of the small sections II to VI is in part explained by their greater inaccessibility. Sections III and IV are each represented by a single Brazilian species, of which the former, for lack of sufficient material, Robinson placed in this genus

[4] Specimens collected by the author will be deposited in the Gray Herbarium and duplicates in the National Museum, Washington, the Instituto di Biologia, Mexico, and the University of Michigan, Ann Arbor. References to other collectors' numbers will permit the reader to examine a number of other specimens in various herbaria.

TABLE I
Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
Leptanthodium I (2 sp.)			Annuals	*B. diffusa*[1]	III	Panama	San José Is.	I. Johnston 1281 1/29/46		18
Bulbostylis VII	1	Clavigera (2 sp.)	perennial herbs, a little woody at the base	*B. scoparia*	I	Oax., Mex.	n. of Oaxaca, along trail to San Juan del Estado	L. O. Gaiser[2] 39, 10/15/50	9	
					II	Mich., Mex.	n. side of Mt. Punguato just w. of Morelia	L. O. Gaiser 54, 10/25/50	9	
	3	Microphyllae (4 sp.)	shrubby xerophyte	*B. Nerinii*	I	Cal.	San Rafael Hills, w. of Pasadena, Los Angeles Co.	L. C. Wheeler 6372, 10/11/52		18
				B. microphylla	Ia	Wash.	2 mi. w. Asotin, Asotin Co.	M. Ownbey, 3168a 10/49	9	18
					II	Cal.	Rancho Santa Ana B. G.	P. Munz, 11/8/48		18
				B. scabra	I	Col.	Mesa Verde Nat. Park, Montezuma Co.	W. A. Weber 5243 9/14/49		18
	4	Parvulae (4 sp.)	mostly perennial herbs	*B. dentata*	I	Tex.	Neuces R. at Barksdale, Real Co.	H. R. Reed 683 11/2/49		18
				B. brachyphylla	II	Col.	Mesa Verde Nat. Park, Montezuma Co.	W. A. Weber 5216 9/10/49		18
					III	Okla.	3 mi. n. of Kenton, Cimarron Co.	U. T. Waterfall 9717 10/7/50	9	18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
	5	RETICULATAE (7 sp.)	Perennial herbs from a woody caudex	*B. venosa*	IV	Ariz.	Santa Catalina Mts., Pima Co.	K. F. Parker 7405 10/19 50	9	18
				B. oliganthes	I	Mich., Mex.	n. side of Mt. Punguato just w. of Morélia	L. O. Gaiser 55 10/25/50	9	18
				B. reticulata	I	Mor., Mex.	23 kms. from Cuernavaca on the Yautepec road	L. O. Gaiser 82 11/3/50	9 irr.	18*
				B. verbenacea	I	Jal., Mex.	On the Ameca Hwy. 38 kms. from Guadalajara	L. O. Gaiser 59 10/26/50	9	
					Ia	Jal., Mex.	On the Ameca Hwy. 38 kms. from Guadalajara	M. S. de Castillo 12/50		18
	6	AMPLEXICAULES (4 sp.)	Perennial herbs or a little woody	*B. cuspidata*	I	Jal. Mex.	El Colli, 30 kms. S. W. of Guadalajara	M. S. de Castillo 2/12/52		18
				B. betonicaefolia	I	Ariz.	Santa Catalina Mts., Pima Co.	F. W. Gould 5237 10/4/48	9	18
				B. amplexicaulis	I	Ariz.	Mt. Lemmon, Pima Co.	K. F. Parker 7403 10/11/50	9	18
	7	BRACHIATAE (6 + 2 sp.)	Perennial herbs or shrubs	*B. Coulteri*	IV	Baja Cal., Mex.	19.2 mi. s. w. of San José del Cabo	A. Carter, L. Kellogg & A. Alexander 2240 12/17/47		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
				B. megaphylla	I	Baja Cal., Mex.	Arroyo Hondo, n. side of Cerro la Giganta	A. Carter, L. Kellogg & A. Alexander 2056 11/27/47		18
	8	BACCHARIDEAE (7 sp.)	Xero-phytic shrubs	*B. laciniata*	I	Tex.	Sul Ross College Hill, Alpine	B. H. Warnock 12/4/48		18
					II	Dur., Mex.	Mexico-Chihuahua Hwy. 1160 Kms. from Mexico	A. G. Johnson 8, 10/20/50		18
				B. desertorum	I	Cal.	Citrus Expt. Sta., Riverside, Riverside Co.	L. C. Wheeler 6380, 10/30/52		18
				B. californica	I	Cal.	Altadena, Los Angeles Co.	L. C. Wheeler 12/6/47	9	18
					II	Cal.	San Gabriel Mts., San Bernardino Co.	L. C. Wheeler 10/9/47		18
					IV	Cal.	Rancho Santa Ana B. G., Anaheim	P. Munz 11/8/48		18
					V	Ariz.	Santa Rita Mts., Santa Cruz Co.	F. W. Gould 5234, 9/27/48		18
					VI	Ariz.	Mt. Lemmon, Pima Co.	F. W. Gould 5236, 10/4/48		18
					XI	Cal.	Carmel Valley, Monterey Co.	Mrs. R. Ferris 10/29/49		18
					XII	Col.	3 mi. n. Lyons, Boulder Co.	W. A. Weber 3/8/50		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
					XIII	Ariz.	28 mi. n. e. Tucson, Pima Co.	K. F. Parker 7128, 10/10/49		18
					XIV	Col.	Mesa Verde Nat. Park, Montezuma Co.	D. Watson 10/15/50		18
					XV	Utah	3 mi. n. e. Provo, Wasatch Co.	B. F. Harrison 11/16/50		18
					XVI	Ariz.	Santa Catalina Mts., Pima Co.	K. F. Parker 7404, 10/11/50		18
					XVII	Ariz.	Coronado Nat. Park, 9000 ft.	A. G. Johnson 19, 10/26/50		18
					XVIII	Ariz.	Chiracahua Mts., 7000 ft.	A. G. Johnson 20, 10/27/50		18
				B. veronicaefolia var. *veronicaefolia*	II	Pueb., Mex.	On Hwy to Puebla City, 42 kms. from Mexico	L. O. Gaiser 14, 10/13/50	9	
				B. veronicaefolia var. *senilis*	I	Pueb., Mex.	On road from Mexico to Orizaba, near Azumbillo	L. O. Gaiser 21, 10/13/50	9	
				B. veronicaefolia var. *umbratilis*	II	Dur., Mex.	Durango-Chihuahua Hwy. 870 kms. from Mexico	A. G. Johnson 7, 10/20/50		18
				B. Palmeri var. *amphothrix*	I	Dur., Mex.	Mexico-Durango Hwy. ca. 870 kms. from Mexico	A. G. Johnson 3, 10/18/50		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
					II	Dur., Mex.	Mexico-Durango Hwy. ca. 870 Kms. from Mexico	A. G. Johnson 4, 10/18/50		18
	9	Coleosanthus (22 sp.)	Perennial herbs and shrubs	*B. Rusbyi*	II	Ariz.	Santa Catalina Mts., Pima Co.	F. W. Gould 5237, 10/4/48	9	18
					III	Ariz.	Coronado Nat. Park	A. G. Johnson 17, 10/26/50		18
					IV	Ariz.	Between Pinery Canyon & Bar-foot Pk. Coro-nado Nat. Park	A. G. Johnson 21, 10/27/50		18
				B. glomerata	I	Mor., Mex.	Near bridge, Calle Tunnell, Cuernavaca	L. O. Gaiser 11, 10/9/50	9	
					IV	Mor., Mex.	Ca. 20 kms. from Cuernavaca on Yautepec road	L. O. Gaiser 83, 11/3/50		18
					V	Guer., Mex.	4 kms. from Taxco on Hwy. to Mex.	L. O. Gaiser 87, 11/4/50	9 irr.	
				B. paniculata	I	Oax., Mex.	Along the road from San Felipe village to mt.	L. O. Gaiser 26, 10/18/50		18
					III	Oax., Mex.	510 kms. from Mexico City to Oaxaca, just past Huitzo	L. O. Gaiser 35, 10/19/50		18
					X	Oax., Mex.	At the foot of Monte Alban, near Oaxaca City	L. O. Gaiser 49, 10/20/50		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
					XI	Jal., Mex.	On the Ameca Hwy. 38 kms. from Guadalajara	L. O. Gaiser 57, 10/26/50		18
					XII	Chiap., Mex.	Eastern region of Tuxtla Gutierrez	F. Miranda 4/28/51		18
				B. secundiflora var. *secundiflora*	II	Mex., D. F.	Molino de Flores, 3 mi. e. of Texcoco	E. Matuda 25720, 11/18/51		18
				B. secundiflora var. *nepetaefolia*	I	Mich., Mex.	Along walls at Santa Maria, 5 kms. from Morélia	L. O. Gaiser 51, 10/23/50	9	
				B. tomentella	IV	Pueb., Mex.	Near Cumbres de Acultzingo, ca. 8000′, Puebla to Orizaba	L. O. Gaiser 22, 10/13/50		18
					V	Oax., Mex.	Between San Felipe village and Oaxaca, along fences	L. O. Gaiser 33, 10/18/50	9	
					VII	Mex., D. F.	Venacho Mt., Amecameca	E. Matuda 25884, 12/9/51		18
				B. nutanticeps	I	Mexico, D. F.	Woods below el Desierto de los Leones	L. O. Gaiser 6, 10/8/50		18*
				B. pendula	III	Pueb., Mex.	Ca. 205 kms. from Mexico City on Jalapa to Puebla road	L. O. Gaiser 25, 10/14/50	9 irr.	

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection		Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No.	
	No.	Name							n	2n
				B. argyrolepis	I	Alajuela, Costa Rica	Rio de los Ahogados Carrizal	J. Leon 5/2/50	9	18
				B. adenocarpa var. *glandulipes*	I	Sacat., Guatemala	Northern outskirts of Antigua, above "Candelaria" Coffee Plantation	L. O. Gaiser 1, 9/25/50	9	18
					III	Guat., Guatemala	Escuela d'Agricultura, near Villa Nueva	L. O. Gaiser 3, 9/26/50		18
					V	Sacat., Guatemala	On left slope of Volcan Agua, Antigua, on Finca Carmona	L. O. Gaiser 5, 9/29/50		18
					VI	Honduras	Quebrada Dantas, El Paraiso	L. Williams 17204, 3/12/50	9	18
				B. pacayensis	I	Mor. Mex.	Oaxtepec, n. w. of Cuautla	E. Matuda 26035, 3/16/52		18
				B. floribunda	I	Ariz.	Santa Catalina Mts., Pima Co.	K. F. Parker 7408, 11/4/50		18
EUBRICKELLIA VIII (18 sp.)			Perennial herbs or shrubs	*B. oblongifolia* var. *linifolia*	II	Ariz.	Betatakin, Navajo Co.	J. T. Howell 24544, 6/22/48		18
				B. Greenei	I	Cal.	South Fork Indian Creek, Siskyou Mts., Siskyou Co.	L. C. Wheeler 6248, 9/18/52		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection		Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No.	
	No.	Name							n	2n
				B. Wislizeni	I	Dur., Mex.	Durango to Chihuahua Hwy. 1455 kms. from Mexico	A. G. Johnson 16, 10/20/50	9	18
				B. macromera	I	Baja Cal., Mex.	Arroyo Hondo, n. side of Curode la Giganta	A. Carter, M. Alexander & L. Kellogg 2058, 11/27/47		18
				B. peninsularis	I	Baja Cal., Mex.	W. side of Cabin la Laguna, Sierra la Laguna	A. Carter, M. Alexander & L. Kellogg 2371, 12/5/47	9	18
				B. grandiflora	II	Wash.	Ca. 1.6 mi. s. of Seven Mile Bridge Spokane R., Spokane Co.	Mrs. Gaines 150, 9/25/48	9	18
					III	Ariz.	Santa Catalina Mts., Pima Co.	K. F. Parker 7343, 9/20/50	9	18
				B. incana	I	Cal.	15 mi. e. of Balser, San Bernardino Co.	M. Ownbey 9046, 7/9/46		18
					II	Cal.	Rancho Santa Ana B. G., Anaheim	P. Munz 11/8/48		18
				B. lanata	I	Jal., Mex.	Along rwy. track near Hwy. 48 kms. from Guadalajara on Ameca Road	L. O. Gaiser 60, 10/26/50		18

TABLE I—Continued

Chromosome Numbers in Species of *Brickellia*

Section & No.	Subsection No.	Subsection Name	Nature	Species Name	No.	State	Locality	Collector, No., Date.	Chromo. No. n	Chromo. No. 2n
					II	Jal., Mex.	On slopes of Barranca, Guadalajara	L. O. Gaiser 64, 10/27/50		18
					IV	Jal., Mex.	63 kms. n. w. of Guadalajara in Barranca at Tequila	M. S. del Castillo 12/11/50		18
Macro-brick-ellia IX (1 + 1 sp.)			Perennial herbs with tubers	*B. monocephala*	I	Mex., D. F.	El Salto Hills, n. w. of Huehuetoca	D. B. Gold & C. Eheberle 8/12/51		18

* This from a somatic division in the young stylar tissue.

[1] The authorities for species have been omitted from the table. All species are as given by Robinson (1917) except *B. megaphylla* Jones and *B. nutanticeps* Blake (1943) which replaces the invalid *B. nutans* (HBK) Robinson.

[2] In the case of the author's own collections, the *n* number was obtained from the meiotic material fixed in the field and in other accessions from plants grown in the greenhouse, from seeds obtained from collectors.

somewhat doubtfully. Sections II[5] and VI each consist of three Mexican species and section V of the same number from western United States. There is good representation of eight of the nine subsections of Section VII, lacking only the monotypic species of subsection 2. Section VIII is equally well represented by about half of its species. Section IX is fortunately represented by *B. monocephala* Robinson[6] which is singular in having the largest heads and they are borne singly on peduncles. Though it was the only species belonging to the section in Robinson's treatment, more recently one other has been added, *B. Robinsoniana* Blake (1941). From the number of species given in brackets below each subdivision in table I, it is evident that in general each is represented by about half of its total number.

[5] More time and effort was spent in hunting for the herbaceous *B. pulcherrima* Robinson on the limestone mountains both at Jautepec, in Morelos, and about Izucar de Matamoros, in Puebla, than in the search for any other species. Dr. F. Miranda, who in 1941 had made a collection of it in the latter locality, felt that the unusually dry period in 1950 would have been very unfavorable for this more delicate and attractive species, the only one reported confidently as worthy of horticultural use. The former type locality presented the additional disadvantages of a closely grazed mountain, now riddled with limestone quarries.

[6] This species named by Robinson from a specimen collected by C. G. Pringle in 1901 in the hills of El Salto, Hidalgo, was also collected by Dr. Manuel Martinez Solorzano, who accompanied Pringle on trips when he was in the vicinity of Morelia (see Davis (1936) p. 242). When in that city, I saw the specimens collected by this guide of Pringle's, in the Michoacán Museum, and fortunately made the acquaintance of his son, a medical doctor there, Dr. Eugenio Martinez Baez, who is the son mentioned in Pringle's diary. Therefore he was able to take me to the exact locations he had visited with his father and Pringle. What was then a natural park, Juarez Park, where *B. monocephala* had been collected, was much like any other city park and the native vegetation had been pushed back. Upon visiting other places in Mexico on a list prepared from the given locations of specimens in the Gray Herbarium, the same condition was found frequently, but more harrowing still were the generally overgrazed hillsides and denuded forest slopes. Nevertheless I would like at this time to pay tribute to the monumental work represented by the collections of Pringle, not only for the actual specimens but also for the locations which along with his field notes made possible the excellent compilation by his daughter, Mrs. H. B. Davis. This should be a "must" reference for any field worker in regions of Mexico visited by this hardy earlier botanist. With the rapidly changing conditions for native plants, it is of great help to know just where certain species did grow fifty years ago. After referring to the account of Pringle's journeys to the hills of El Salto in Hidalgo for *B. monocephala*, Mr. D. B. Gold of Mexico City, made a trip there in August, 1951, and thus one year later, made good for this author's failure to find that rare species about Morélia.

(*To be continued*)

Dipsacus laciniatus in Illinois.—On July 26, 1952, while driving along west 55th Street in Chicago, I noticed some whitish flowers among the purple ones of a thistle in a weedy area at the roadside. Thinking that here might have been a white-flowered form of the thistle, *Cirsium vulgare* (Savi) Tenore, I stopped the car and investigated. A close look revealed what a glance at thirty-five miles an hour had not. The whitish flowers were those of a teasel, later identified as *Dipsacus laciniatus* L. According to the eighth edition of Gray's Manual, this species is found from Massachusetts to Michigan; thus, the present Illinois record represents a westward extension of its range. The plant was seen not only at the place where I first noticed it but also in another weedy field across the street, in a similar area about one mile further west on 55th Street, and along the Burlington right of way at Clarendon Hills. Specimens have been placed on file in the Illinois Herbarium of the Chicago Natural History Museum.—John W. Thieret, Chicago Natural History Museum.

Another Color Form of Epilobium latifolium L.—In the summer of 1947, we found along Glen Highway, in Alaska, an extensive colony of *Epilobium latifolium* L. With the typical species, were also represented the albino, forma *leucanthum* (Ulke) Fernald, and another variation in which the petals are white and sepals purplish. So far as I am aware, the latter form has no name and I propose to designate it *f. Munzii*.

Epilobium latifolium L., forma **Munzii,** nov. f.—Petalis lacteis, sepalis roseis vel purpureis.—Alaska: Glen Highway, Mile 141, July 27, 1947, *Dutilly, Lepage & O'Neill, no. 21656* (Holotype: Catholic Univ. of America, Wash.).

With forma *leucanthum*, both petals and sepals are white, while in this new form only the petals are white, the sepals remaining as in the typical species. Forma *Munzii* parallels *Epilobium angustifolium* L., forma *spectabile* (Simmons) Fernald. It is a pleasure to name this plant for Dr. Philip A. Munz, a specialist on the Onagraceae, who studies our critical collections of *Epilobium* every year.—Ernest Lepage, ecole d'agriculture, rimouski, qué. canada.

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CHROMOSOME STUDIES IN KUHNIINAE (EUPATORIEAE). I. BRICKELLIA

L. O. Gaiser

(*continued from p. 267*)

Also, from the table it can be seen that those included give a good representation geographically, as well as sectionally, if we except the two from Brazil. Of those studied, one species is so far known only from Costa Rica and a second came from Honduras, Guatemala and Chiapas in the very south of Mexico. Sixteen came from the plateaus of central to south Mexico, and four from the deserts and mountains of Baja California. At least three are distinctly north Mexican while fourteen are largely from southwestern United States, though there is some overlap to the northern part of Mexico, while others extend northward. Two of the latter, as well as two other species, are definitely from the northern limit of the range of the genus.

Chromosome Number and Geographical Distribution

The number of chromosomes in 80 accessions, representing 41 species, is 9 at meiosis or 18 in the somatic cells. Not a single instance of polyploidy or aneuploidy was found in the examination of almost half of the species of the genus although some meiotic irregularities were observed.

This uniformity of chromosome number means the same number for a small shrub of the temperate zone like *B. microphylla* (Nutt.) Gray, which came from Asotin County, Washington, and thus approaches the Canadian border, and *B. argyrolepis*, endemic in Costa Rica. Though the latter country is deep in the tropical zone, this singular species of *Brickellia* was collected at an elevation of 1450 meters. Similarly all the perennial

species from Central America and south and central Mexico came from the plateau states, at elevations of from about six to eight thousand feet. Thus this genus of the western Cordillera has remained mostly montane and lives under temperate conditions. The southern species (omitting the two questionable species in Brazil), though they thrive in a more equable climate, do not actually endure truly tropical conditions. Somewhat exceptional to this pattern is the annual species, *B. diffusa*, which according to herbarium records, occurs all through the Caribbean. It has evidently become the weed of the genus and appears to be increasing its range. It can tolerate an altitude of less than 100 meters in tropical latitudes, although it does occur with other species on the higher plateaus in Mexico.

It is of interest here to note that Miranda (1944), exploring the eastern slopes of the Sierra Madre, found trees of *Nyssa sylvatica* in the northern part of the state of Puebla at altitudes of 1340 and 1650 meters. The geographical range of this species had been known previously to be from central Maine to Florida and westward to Ontario, Michigan, Arkansas, and Texas. Subsequently Sharp (1951), when comparing the Eocene Wilcox flora with some modern floras, stated that while 93 of 137 designated Wilcox genera were still extant in eastern United States, 48 were present in the flora of the eastern escarpments in Mexico. These figures show a high correlation between the vegetation of these plateaus of Mexico and that of the Carolinian Zone. In contrast to *Nyssa*, where the same species is found in northern United States and central Mexico, in the genus *Brickellia*, few species, if any, are common to two such different latitudes. In the introduction to his paper, Robinson (*l. c.*) states that only four species can be said to have broad ranges. These are the annual *B. diffusa*, and three perennials, *B. californica*, *B. grandiflora*, and *B. oblongifolia*. None of them can equal the range of *Nyssa*. In this there is perhaps seen the difference between a large plastic genus, such as *Brickellia*, with eighty to ninety species, and a more conservative one, as *Nyssa*, with six species in America, even when allowance is made for varying bases of specific determination. Or is it perhaps indicative of one genus having evolved with its species becoming widespread in the time of the more uniform mild climate prior to the Pliocene, while of

the other, great speciation at least has taken place in conjunction with and following the climatic deterioration of that time. The earliest fossil records of the *Compositae* are in the Pliocene while those of *Nyssa* are known from the Cretaceous.

Chromosome Number and Amount of Woodiness

Uniformity of chromosome number means the same number for small and large shrubs, perennials, from the herbaceous to those at least more woody at the base, and one annual herb. Study of wood anatomy of the genus has not been undertaken. The genus is believed to have no real tree-form, however, Robinson, as is often necessary for the monographer with only the herbarium specimens and collectors' notes, omitted the height of some species and gave three meters as the tallest. At least five species approximate this height, of which three shrubs, *B. argyrolepis*, *B. pacayensis* (Coult.) Robinson and *B. pendula* (Schrad.) Gray and one herb *B. nutanticeps* Blake, are included in the present study. As seeds of the first of these were sent to me by the collector[7] in Costa Rica, it was possible to obtain the information from him directly that "The seeds of *Brickellia* sent came from shrubs that were 8 to 12 feet high; most have stems that were about 2 inches in diameter at the base, but the lateral stems were from ½ to ¾ inch wide." Two seedlings of these were grown in the greenhouses of the Biological Laboratories of Harvard where they were necessarily limited in height by the glass roof. In two years they had produced stems that were one inch in diameter at the base. They were woody except for a very small pithy center. This fraction of pith however increased gradually in higher internodes. Professor E. Matuda wrote that *B. pacayensis*, which he collected at the margin of bush, among secondary growth, was an herbaceous shrub 2 meters high. *B. pendula*, as seen in several locations by the author, did not exceed that height, while stems of the more herbaceous *B. nutanticeps* reached 3 meters. Thus, it seems probable that the species, with an altogether limited range in Costa Rica, could be called (lacking definitive knowledge of the doubtful ones in Brazil) not only the most southerly species but the tallest and most woody. So far as is known at present, any species occurring to the south of it

[7] Mr. Jorge Léon.

in Panama, or in the West Indies, is found also north of Costa Rica, in Guatemala or Mexico. The unvarying number of chromosomes in these species would indicate that for this genus there is no correlation of chromosome number with the amount of woodiness. Confirmation of this is added in finding the same number in the one annual herb which it was possible to study, *B. diffusa.*

The herbaceous perennials vary from the more delicate and slender ones such as *B. brachyphylla* Gray or *B. grandiflora* (Hook.) Nutt. to those with stiff stems, six and nine feet in height, as *B. scoparia* (DC) Gray and *B. nutanticeps*, respectively. In this they resemble large-leaved species of *Eupatorium* of the temperate region. Others become more branched, form bushy clumps and have been referred to as woody at the base. In this genus there is no sharp line between this type of perennial and the shrub. Varying somewhat from these tall intermediates between the herbaceous and shrubby types, are the species of the subsection *Reticulatae*, four of which were collected. All have a thick woody caudex, giving rise to a number of stems with somewhat lanceolate leaves. In these characters they resemble *Liatris* of the *Punctatae* series. Also at least two herbaceous species, *B. monocephala* and *B. hymenochlaena* Gray, are known to have fleshy rhizomatous roots. Both of these have large heads and broad phyllaries, characters also occurring in the *Scariosae* series of *Liatris.*

Chromosome Morphology or Karyology

general observations

The uniformity of chromosome number in the genus *Brickellia* does not necessarily mean a similar uniformity of karyotypes. Somatic divisions have been found in seventy-one accessions representing thirty-nine species, exclusive of varieties. In two of these species, mitosis was seen only in cells of young stylar tissue of the flower material fixed in the field. Of the other thirty-seven, studies have been made in comparable preparations of root-tips from germinating seeds or from seedlings as they were grown in the greenhouse.

Though striking contrast in the morphology of the chromosomes was not found, differences in their lengths do appear. To

the general classes, long, medium and short, applicable to the majority of the species, a fourth class, the short short has been added for a small minority. As adopted from the language of fiction writers, this compound term applies to the unusually small forms found in the short group. Again by combining observations of the position of the centromere with length, an attempt was made to classify* in table II the chromosomes of all species, of which sufficient material was available. In two from Baja California, *B. macromera, B. megaphylla,* and *B. oblongifolia* Nutt., var. *linifolia* (D. C. Eaton) Robinson, too few seeds proved viable to give an opportunity for adequate comparisons.

It is not difficult to differentiate chromosomes which are long and short but as transitions of those of either class to the medium are not abrupt, those on the border line are not easily determined. Also while early stages of long and medium chromosomes regularly had centromeres in median, submedian, and subterminal positions, the few short chromosomes of most species often appeared as straight rods. However an examination of enough cells usually showed them sometimes as V-shaped, indicating that they were mostly medianly constricted. In karyotypes having a majority of short chromosomes, further classification of these was possible in the well-studied species, *B. californica* (Torr. & Gray) Gray, represented by thirteen accessions. The longest pair of chromosomes in most species of *Brickellia* was recognizably long submedian (Lsm) and the next long median (Lm). In some the third in length were called long subterminal (Lst) while in other species such a pair debatably might be called medium in length (Mst). Similarly from the closely graduated sizes there were other questionable classes in listing the species. No claim for absolute differentiation of these merging forms is made. It is hoped that the overall pattern of the karyotypes can be compared in the photomicrographic figures, with the aid of the classification in table II. The numbers of the particular accessions studied, occurring in the

* The abbreviations adopted here are as follows: Using capital letters to express length, long chromosomes with median, submedian, and subterminal constrictions are represented as Lm, Lsm, and Lst respectively; chromosomes of medium length similarly constricted, as Mm, Msm, and Mst, and short chromosomes similarly, Sm, Ssm, and Sst. The new short short class becomes SS; when medianly constricted, SSm, and when terminally, SSt.

TABLE II.—Karyotypes in

Section	Subsection	Species	No. of the Accessions Studied	Pairs of				
				Lm	Lsm	Lst	L with sat.	Mm
I		*B. diffusa*	III					1
VII	*Microphyllae*	*B. Nevinii*	I	1	1	1		2
		B. microphylla	Ia, II	1	1	1		2
		B. scabra	Ib	1	1	1		2
	Parvulae	*B. dentata*	I	1	1	1		2
		B. brachyphylla	II, III	1	1	1		2
	Reticulatae	*B. venosa*	IV	1	1	1		2
		B. oliganthes	I	1	1	1		2
		B. verbenacea	Ia	1	1	1		2
	Amplexicaules	*B. cuspidata*	I	1	1	1		2
		B. betonicaefolia	I	1	1	1		1
		B. amplexicaulis	I	1	1	1		1
	Brachiatae	*B. Coulteri*	IV		1	1	1	2
	Baccharideae	*B. laciniata*	I, II					1
		B. desertorum	I					1
		B. californica	I–XIII					1
		B. veronicaefolia var. *umbratilis*	I					1
		B. Palmeri var. *amphothrix*	I, II	1	1	1		2
	Coleosanthus	*B. Rusbyi*	II, III, IV					1
		B. glomerata	IV	1	1	1		2
		B. paniculata	I, III, X	1	1	1		2
		B. secundiflora var. *secundiflora*	II	1	1	1		2
		B. tomentella	IVa, VII	1	1	1		2
		B. argyrolepis	Ia	1	1	1		2
		B. adenocarpa var. *glandulipes*	III	1	1	1		2
		B. pacayensis	I	1	1	1		2
		B. floribunda	I					1
IX		*B. Greenei*	I					1
		B. Wislizeni	I	1	1	1		2
		B. peninsularis	I	1	1	1		2
		B. grandiflora	II, III	1	1	1		3
		B. incana	I, II					1
		B. lanata	I, II, III	1	1	1		2
X		*B. monocephala*	I	1	2			4

Species of *Brickellia*

Chromosomes								
Msm	Mst	M with sat.	Sm	Ssm	Sst	SSm	SSt	General Remarks
1	1		4			2		1 pr Sm may be Ssm
1	1		2					
1	1		2					
1	1		2					
1	1		2					Chromosomes all seem shorter than *B. brachyphylla*
1	1		2					
1	1		2					or are there 2 Lsm 0 Lst?
1	1		2					
1	1		2					
1	1		2					
3	1		1					possibly 2 Msm and 2 Mm
3	1		1					possibly 2 Msm and 2 Mm
1	1		2					or 3 prs. S and 1 pr. M
1			4			2	1	1 pr. intermediate M to S? 2 or 3 prs. SSm?
1			4			2	1	1 pr. intermediate M to S? 2 or 3 prs. SSm?
1			2	1	1	2	1	1 pr. = Mst or Sst? 1 pr. Ssm or SSsm?
1			3	1		3		possibly a little longer than in *B. californica*
1	1		2					
1			3	1		3		1 pr. Ssm may be Sm in accession II
1	1		2					
1	1		2					
1	1		2					
1	1		2					
2	1		1					or 2 Lsm and 1 Msm
2	1		1					or 2 Lsm and 1 Msm
2	1		1					
1			3	1		3		2 prs. M more nearly approach L than in *B. californica*
1		1	1	1	1	2	1	
2	1		1					1 pr. Msm = Lsm? and 1 pr. Mm = 1 Sm?
2	1		1					1 pr. Msm = Lsm? and 1 pr. Mm = 1 Sm?
2	1							
1		1	1	1	1	2	1	
1	1		2					
1	1							short arm of 1 pr. Lsm shorter than that of other

second column, refer to those given in table I along with their places of origin.

Due to immaturity or at times paucity of seeds received, equally abundant and favorable material was not obtained of each accession. Of some it was possible to repeat the studies and vary the technique more because for a time at least, plants grew successfully in the greenhouse. For contrast, preparations were made of *B. microphylla* by use of Meyer's (1945) paradichlorobenzene technique, and contraction of the chromosomes was obtained. This sometimes emphasized the centromere region in longer chromosomes to good advantage. However, reduction in length was detrimental to the study of the shortest ones in almost obliterating the constriction region as well as the delicate satellites. Such a limitation of its use in this genus can be seen in the clear figure of *B. microphylla* (fig. 35) from a particularly favorable aceto-carmine smear in which there were dozens of cells like the one photographed.

Though careful drawings were made of the karyotypes of fifteen species for comparison with a number of species of other closely related genera of the *Kuhniinae* (MS in preparation), only the photographic illustrations were used here. These were made of preparations without pretreatment for contraction and of fairly comparable metaphase stages. As this phase is of some duration, the chromosomes on the equatorial plate in any species may vary slightly in the amount of condensation. However, this margin of variation was taken into consideration by study of a sufficient number of cells and can be illustrated here by three cells of *B. glomerata* from one and the same Feulgen slide preparation (figs. 14, 42, 43). The first figure is characteristic of the karyotype of this species. The second shows slightly more condensation. The third, however, is most exceptional and equals or exceeds the contraction produced by paradichlorobenzene (cf. fig. 35). This cell, without the study of many others, would suggest quite erroneously, that *B. glomerata* was similar to one of a minority of species with very small chromosomes. This was the only occurrence of such contracted units resulting from Feulgen's, but following any technique, variations may occur which are recognized by ample study. While necessarily various stages were studied for the purposes of the interpretation of a

karyotype, for the listing in the table, comparable stages in each species had to be recognized. The best spread of chromosomes was selected for photography. A clear example of karyotypes of slightly more and less condensation is illustrated by the figures of similar dermatogen cells in the closely related species *B. amplexicaulis* Robinson and *B. betonicaefolia* Gray (see figs. 24, 25). The table compares species of one subsection with those of another subsection or section as well as different accessions of individual species.

ANALYSES OF KARYOTYPES TREATED BY SECTIONS

SECTION I. LEPTANTHODIUM.

From the few viable seeds of an herbarium sheet of *B. diffusa*, collected in 1946, enough mitoses were seen to allow a comparison of the chromosome types with other species, although none were very good for photography. Figure 1 gives the impression of consisting of units of almost equal size, not merely because they are a little crowded, but actually because no long chromosomes are included. At an earlier stage, before they had become well organized on the plate and were less condensed, three classes were recognizable by differences in length. Two medium chromosomes which were submedianly constricted were the longest of the set. In figure 31, they can be seen on the periphery at right and left bottom. In contrast, one of the same class, medianly constricted, appears at upper right and of the short class at upper left. Though no preparations of this species were attempted with paradichlorobenzene, one anaphase plate presented almost as clearly in miniature the forms of these short chromosomes (fig. 32). In all there are six of the medium class which appear paler somewhat diagonally across the bottom in the figure and could be resolved as a pair each with median, submedian, and subterminal constrictions, respectively. Continuing almost clockwise, there are six short ones with four of the short short class in the center.

This karyotype with smaller chromosomes in one annual species of the first section differs greatly from those in most species of perennials studied. However, it is very similar to a small minority of them.

SECTION VII. BULBOSTYLIS.

With this section begins the analysis of numerous perennial species. Of subsection *Clavigera*, only young flowering material of *B. scoparia* was collected in Mexico. Those meiotic chromosomes (fig. 50) are a little smaller than others collected at the same time and prepared in the same way (cf. figs. 51, 53). This suggests that the karyotype of *B. scoparia* could be expected also to be composed of somewhat smaller units.

SUBSECTION MICROPHYLLAE. In his introduction, Robinson referred to this subsection as containing four very closely related species which he recognized because they varied in types of pubescence and in their geographic ranges. Three of the four species were studied cytologically.

In figure 35 of *B. microphylla Ia* after treatment for contraction, the abbreviated types of the chromosomes can be recognized. Across the top of this plate are seen the two longest submedian and one of the long subterminal chromosomes with the mate of the latter lying just below it. The two long median chromosomes are at the lower right corner with two medium submedian ones occupying the right side. The four short chromosomes form a line diagonally from that corner to the upper

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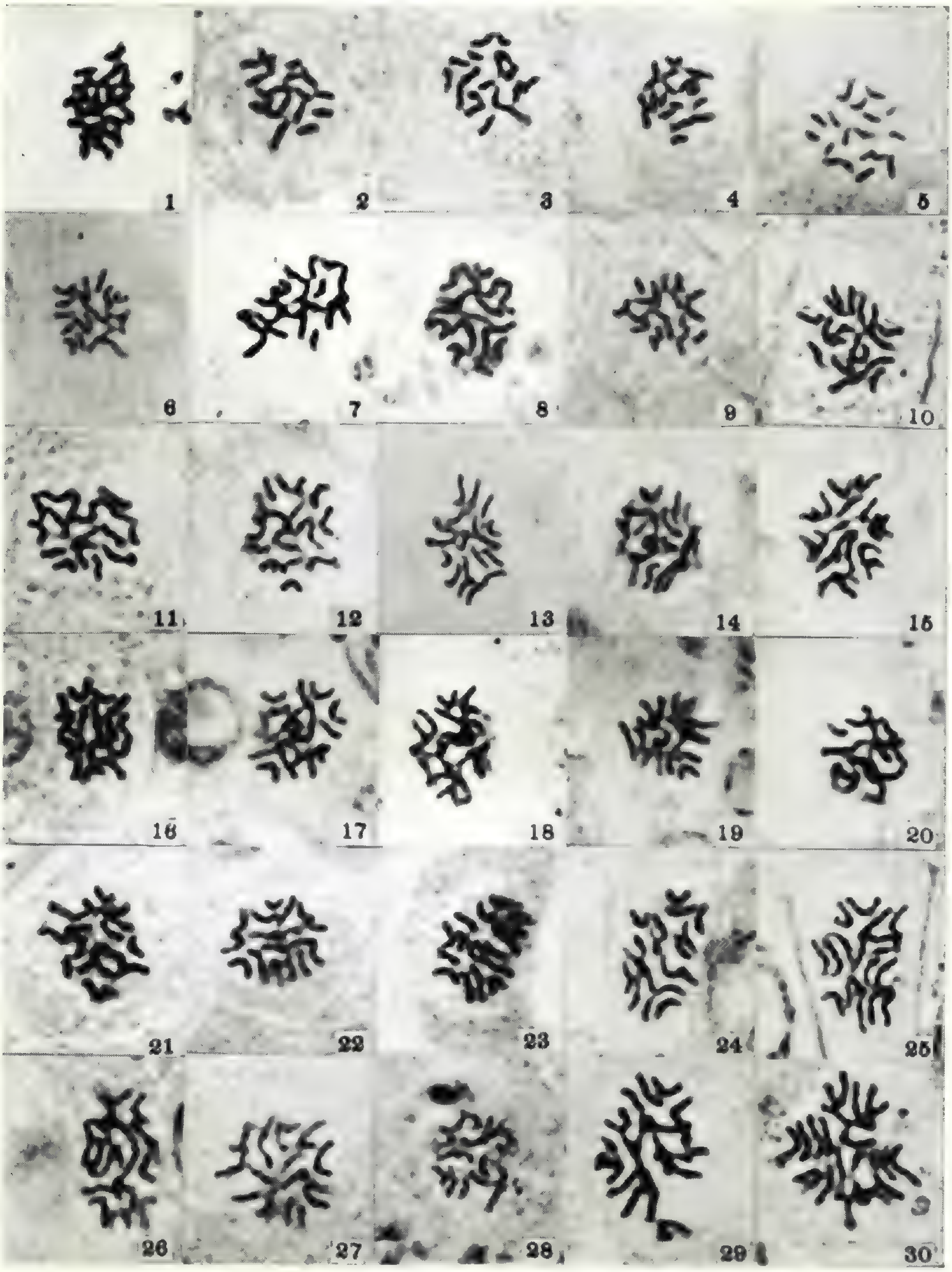
Plate 1194

EXPLANATION OF FIGURES

Figs. 1–30 are from nearly comparable metaphase plates in root-tips. 1. *B. diffusa* III. 2. *B. Rusbyi* III. 3. *B. floribunda* I. 4. *B. laciniata* II. 5. *B. californica* XV. 6. *B. veronicaefolia* var. *umbratilis* I. 7. *B. dentata* I. 8. *B. brachyphylla* II. 9. *B. incana* I. 10. *B. microphylla* II. 11. *B. scabra* 1b. 12. *B. Coulteri* IV. 13. *B. Palmeri* var. *amphothrix* I. 14. *B. glomerata* IV. 15. *B. venosa* IV. 16. *B. oliganthes* I. 17. *B. verbenacea* Ia. 18. *B. cuspidata* I. 19. *B. lanata* I. 20. *B. secundiflora* var. *secundiflora*. II 21. *B. tomentella* VII. 22. *B. paniculata* I. 23. *B. peninsularis* I. 24. *B. amplexicaulis* I. 25. *B. betonicaefolia* I. 26. *B. Wislizeni* I. 27. *B. adenocarpa* var. *glandulipes* III. 28. *B. argyrolepis* Ia. 29. *B. grandiflora* III. 30. *B. monocephala* I. In this listing, where a species has the letter as well as a numeral, the preparation was from seed sent as a second collection, and where the letter b is appended, the seed represents the third attempt. Preparations were made as follows: Root-tips of seeds fixed in Karpechenko's, and stained in N. G. V., Figs. 7, 8, 9, 10, 12, 18, 23, 24 and stained in Feulgen's Fig. 30. Root-tips of seeds after Belling's, and stained in N. G. V., Figs. 1, 11, 20, 21, and stained in Feulgen's, Figs. 19, 28. All the rest of the root-tips were taken from plants, fixed in Belling's and stained *in toto* in Feulgen's. Figs. 2, 4, 13, 14, 26 at first time, Figs. 5, 15, 16, 22, 25, 27, 29 at a second time, and Figs. 3, 16, 17 at a third time.

The photomicrographs were taken with the use of a Zeiss microscope and a Homal IV lens, except figs. 4, 5, 6 and 13, for which the 90 × objective and 10 × ocular had been used, all figures 2300 ×, reproduced at 1650 ×.

It is a pleasure to acknowledge the assistance of Mr. Paul Brown in the photomicrography.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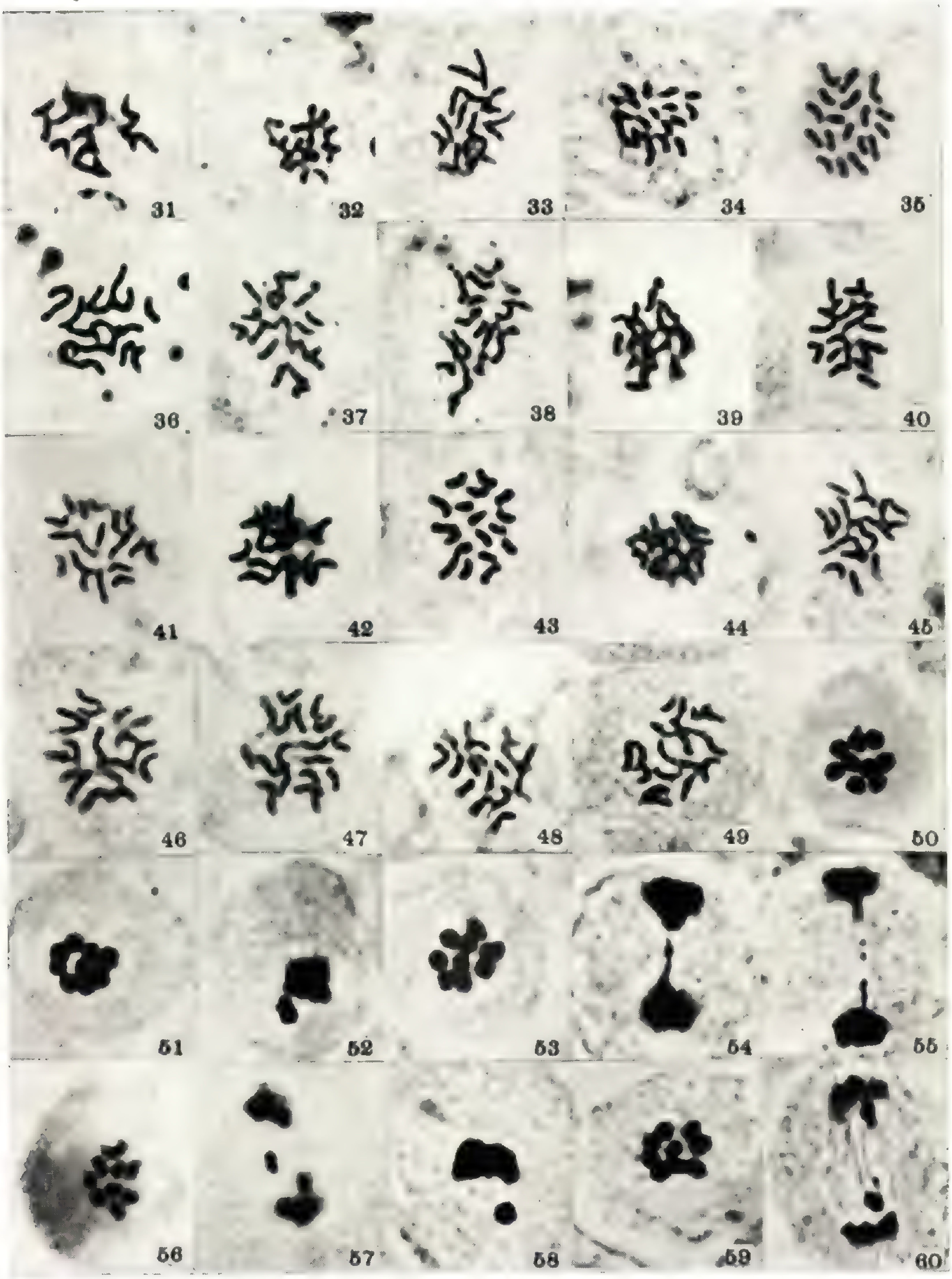
Figures 1–30.



Figures 31–60.

left, and the remainder are of medium length. It is impossible to distinguish any with subterminal centromeres among these. However, the preparations without pretreatment, especially the early metaphase stages, give confirmation of a medium pair subterminally constricted. In figure 10 of a cell of untreated *B. microphylla II*, one chromosome of this pair is clearly seen at the upper left corner. Indeed it is just this pair which was lying over the remnant of a nucleolus that persisted in a cell and so is believed to be the pair with nucleolar attachment. Comparing these cells after normal treatment with those of *B. scabra* (Gray) Nels. (fig. 11), no distinguishable differences can be recognized. In cells having the chromosomes more curved, they appear a little shorter and the plates are less crowded but very similar in each. In both these species, verified in two kinds of preparations, their karyotypes consist of gradually increasing units of length from short to long without striking breaks between any two classes. In preparations of *B. Nevinii I* (Fig. 33), which has just recently been received, there is no variation in the karyotype.

SUBSECTION PARVULAE. This subsection is represented by one accession of *B. dentata* (DC) Sch. Bp. from Texas and two of *B. brachyphylla* Gray from Colorado and Oklahoma respectively. Because *B. dentata* was received from one station only, prepara-

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PLATE 1195

EXPLANATION OF FIGURES

Figs. 31–49. All figures except 32 (anaphase) are metaphase stages from root-tips. 31, 32. *B. diffusa* III. 33. *B. Nevinii* I. 34. *B. desertorum* I. 35. *B. microphylla* Ia. 36. *B. pacayensis* I. 37, 38. *B. Coulteri* IV. 39. *B. californica* XVIII. 40. *B. californica* VI. 41. *B. Greenei* I. 42, 43. *B. glomerata* IV. 44. *B. argyrolepis* Ia. 45. *B. Greenei* I. 46. *B. Wislizeni* I. 47, 48. *B. incana* II. 49. *B. lanata* I.

Preparations were made as follows: Root-tips of seeds fixed in Karpechenko's, and stained in N. G. V., Figs. 36, 37, 38, 40, 47, 48. Root-tips of seeds after Belling's, and stained in N. G. V., Figs. 31, 32, 39, 44. Fig. 35 was stained in aceto-carmine following paradichlorobenzene treatment. All the rest of the root-tips were taken from plants, fixed in Belling's and stained *in toto* in Feulgen's, Fig. 46, at first time, Fig. 49, at second time and Figs. 42, 43, at third time, as referred to re Figs. 1–30. Figs. 33, 34, 41, and 45, at a later time.

Figs. 50–60. Stages of meiosis in pollen mother cells.

50. *B. scoparia* I. 51. *B. verbenacea* I. 52. *B. reticulata* I. 53. *B. glomerata* I. 54, 55. *B. glomerata* V. 56. *B. californica* I. 57, 58. *B. pendula* III. 59, 60. *B. adenocarpa* var. *glandulipes* Ia.

Figs. 50, 51, 53, 56, 59. Polar views of regular I metaphase plates. 52, 58. Lateral views of irregular I metaphase plates. 54, 55, 60. I telophase stages showing chromosome bridges. 57. I telophase with two lagging chromosomes dividing.

tions of root tips from three plants grown from seeds were studied. The chromosomes of the many plates seen (fig. 7), appeared shorter than in *B. brachyphylla* (fig. 8). When early stages of recently segmented spiremes, where the chromosomes are less condensed, were studied, approximately the same types were found as in that species. However, the metaphase of *B. dentata* did seem to represent a diminution in the overall chromosome length just as some species will be referred to as having fuller nuclei and generally longer chromosomes. In cells of *B. brachyphylla* it was clearly seen that the majority of chromosomes were isobrachial since as many as ten V-shaped chromosomes could be seen repeatedly in different cells. The shortest pairs (Sm) were very close to the chromosomes of medium length. Of the four heterobrachial pairs (one each of Lsm, Lst, Msm, and Mst), the long subterminal ones were seen particularly clearly in a Feulgen preparation, to thin out from the short arm into delicate achromatic strands, but no satellites were observed.

SUBSECTION RETICULATAE. Comparable preparations of two Mexican species, *B. oliganthes* (Less.) Gray and *B. verbenacea* (Greene) Robinson, and one from southwestern United States, *B. venosa* (Wooton & Standley) Robinson (figs. 16, 17, 15, respectively), were obtained from germinated seeds and roots of young plants. In no definite way could these karyotypes be distinguished from one another or from those of the *Microphyllae* described previously. In studying numbers of cells, one did not always obtain exactly the same analyses of constriction types but they were usually consistent as to the class lengths. In a third and rarely collected Mexican species, *B. reticulata* (DC) Gray, the seeds were immature and mitotic figures were seen only in the smaller cells of young flower tissue. It was hardly possible to analyze this karyotype. This was regrettable since irregularities in meiosis (fig. 52) found in this plant were possibly indicative of some hybridity. Further interest in it lies in the fact that Robinson considered this species, along with *B. venosa* and another from Guatemala, *B. Kellermani* Greenman, to be very close to *B. oliganthes* in technical characters. Elsewhere (Gaiser, 1952) the significance of my collections has been discussed.

SUBSECTION AMPLEXICAULES. *Brickellia cuspidata* Gray stands apart from the other three species in this sub-section by its cori-

aceous, bright green leaves and is rather distinct by having a marked cusp at the tip of the leaf. Unfortunately only a very few mature seeds were received from Guadalajara this past February. Cells in preparations from them were more satisfactory for study than for photography (fig. 18). The karyotype, however, fell in line with that predominating in the previously discussed groups, comparing more favorably with them than with others of this subsection.

Two of the three allied species, with membranaceous, obscurely pubescent leaves, *B. betonicaefolia* and *B. amplexicaulis*, have been separated in the key by the absence or presence of stipitate glands on the pedicels, respectively. This character is reviewed in a later section of the paper. Cells of *B. betonicaefolia* showed well filled nuclei and moderately large plates as is usual when the chromosomes are longer. Figure 25 of a well spread plate in a rather flattened cell of the dermatogen layer shows a greater predominance of long and medium chromosomes than in previously discussed species, and has only two short ones. These lie below the middle line in the center of the plate. Repeated classification in different cells left questionable the number of hetero- and iso-brachial chromosomes of medium length. Though most of the studies favored three Msm and one Mm, these two classes may be equal. Five instead of four medium chromosomes with the corresponding reduction in number of short ones account for the larger amount of chromatin. Of *B. amplexicaulis*, a very similar narrow cell in the dermatogen is included (fig. 24). Though the chromosomes are of a slightly more condensed stage, the karyotype is obviously very like that of *B. betonicaefolia* and again there are only two short chromosomes. These appear in the figure as two short rods slightly overlying others, one prominently at the center right and the other more faintly, directly opposite, at center left.

SUBSECTION BRACHIATAE. To the six species of this subsection in Robinson's treatment, two more have been added. *B. megaphylla* Jones (1933) is reported by Blake (1945) to have been seen and described by Robinson who considered it close to *B. hastata* Benth. *B. urolepis* Blake (1942) has also been described as being a close ally of that species. All have been reported in limited and widely separated localities in Mexico without over-

lapping (e. g., San Luis Potosi, Coahuila, Sinaloa and particular islands or bays of Baja California) except *B. Coulteri*, which occurs more widely from Arizona to Puebla in Mexico. As mentioned above, only a very limited number of seeds of *B. megaphylla* and *B. Coulteri* from Baja California were received. Of the former, insufficient mitoses were seen for an analysis of its karyotype to be safely made at this time. Of the latter, comparisons were possible in at least four root-tips. While not found in every division figure, preparations of *B. Coulteri IV* frequently showed one chromosome with a conspicuous satellite and sometimes the pair were evident. Both were visible in the cell photographed (fig. 12) though the one which is not on the periphery of the plate is less evident. It was more often possible to find cells which could be photographed, showing clearly one chromosome with a satellite (figs. 37, 38). That the chromosome is long and heterobrachial is shown in all three figures. Also from analyses of them and other cells, we believe it and its mate replace the pair of long median chromosomes. The small appendage is distal to a short arm and these two together are about equal to the long arm of the chromosome. No evidence was found of complete separation, as of a fragment in a cell. It would have been interesting to have had more than one accession for study, especially since *B. Coulteri IV* was one of a small minority of herbarium specimens lacking macroscopic evidence of sessile glands.

SUBSECTION BACCHARIDEAE. The first distinctly different karyotype of a perennial *Brickellia* was found in this subsection of seven species, five of which were studied.

Of *B. laciniata* Gray, it was possible to make comparisons of two accessions received at very different times in this investigation and from separated localities in Texas and Arizona. In the figure shown of the latest accession (fig. 4), one of the longest pair of chromosomes is at the upper right and the next longest at the center top. The respective mates of these two pairs are at lower right but not exactly in focus. These four chromosomes compare favorably with those designated medium (Msm and Mm, respectively) in previous species. Of the seven remaining pairs, it was difficult to determine whether one was intermediate to short and whether of the shortest (SS) there were two or three

pairs. Certainly two little straight rods, lacking any apparent median constriction, would qualify. Though these were determined as SSt they may really be SSm. The interpretations of the two collections is given in table II.

B. californica probably has the widest distribution of any species in the United States, with a range extending eastward from California to western Texas and Colorado and northward to Utah. It was the first species received and more viable material of it has come in than of any other species. Most of the specimens, which came from four different states, fell under var. *californica*. Two of the accessions, XIVc from Mesa Verde National Park, Colorado, and XVII from Coronado National Park, Arizona, tended towards var. *tenera*, but it was uncertain whether they merely represented forms growing in shade. It was possible to examine good mitotic figures of thirteen accessions. The many preparations gave adequate opportunity to make comparisons at different stages and certainly strengthened the conviction that a distinctively different karyotype existed in this subsection. In figure 5 of *B. californica XV*, the chromosomes are approximately as short as those of *B. laciniata*, and again there are none of the long class. The two across the top represent the longest pairs, one with submedian constriction to the left and median to the right. The other two members of these pairs are respectively at lower right and in the center, both not quite in focus for their entire lengths. These chromosomes are certainly not comparable to anything longer than the medium ones seen in many of the previously mentioned species and are, therefore, classed as Msm and Mm. The remaining fourteen appear short and it may be difficult to draw a line between two further classes in this figure. It was for this species, however, as seen in a number of the shortest chromosomes mostly distinguishable at the lower left, that the new class short short was established. A closer analysis was possible because of the many cells available in different and especially earlier stages. Although not a very early metaphase, the cell photographed (fig. 40) of *B. californica XIII* does show the chromosomes of this species when still more elongate. The classification was best made from very favorable preparations of accession XIVc.

From examinations of such figures it was realized with some surprise that the types of these short chromosomes were proba-

bly parallel to the medium ones of the more general karyotype in other species, but on a lower size scale. The short short would then be a reduction of that short class. If one compares these two figures of *B. californica* with the figure of *B. microphylla* after treatment by paradichlorobenzene, and the singular cell of *B. glomerata* in a Feulgen preparation, the likeness is certainly striking (cf. figs. 35, 43). With the suggestion of reduction of the chromatin material in this species, it was more pertinent to find occasionally in cells of at least two preparations, a fairly large terminal body on one of the chromosomes. Fig. 39 shows a cell of *B. californica XVIII* where it is conspicuous because of its position on the periphery of the plate. As it was not found repeatedly in other accessions, it is improbable that it is a regular feature of the karyotype of the species though it may be of this accession. The second collection, XVII, from a higher elevation in the park, which might qualify for variety *tenera*, did not show it. It is larger than the satellite of *B. Coulteri.* No evidence was seen of its becoming completely detached as a fragment, though that may occur. It is certainly suggestive of a means of lost particles which would result in a reduction in the length of the chromosomes.

A collection recently received from Riverside County, California, compares well with the description of *B. desertorum* (Coult.) Robinson and with other specimens so annotated in the Gray Herbarium. In preparations from germinated seeds of it, there was found to be a predominance of short chromosomes similar to that of the two previously described species. The six shortest units across the center of the plate (fig. 34) are considered to belong to the short short class and eight slightly longer ones, almost surrounding them, as short chromosomes. The longest pair, in the bottom row, are clearly Msm and the pair alternating with them, Mm, though they appear slightly fore-shortened. This karyotype could not be recognized as differing from that of *B. californica.* A second recent collection received from San Bernardino County, California, differs from the first in having heads containing a few more florets and larger leaves, with slightly less indumentum. In these characters it approaches *B. californica.* It would be necessary to have many more specimens to determine whether these two species inter-

grade in certain regions. Certainly the karyotype would be of no help in distinguishing the two entities.

The species *B. veronicaefolia* is apparently as abundant in Mexico as *B. californica* is in United States, with a range from Durango to Oaxaca. None of fifteen collections of varieties *veronicaefolia* and *senilis* Robinson, made by the author in Mexico, proved viable, as the seeds were not mature. Of one accession of variety *umbratilis* Robinson, obtained from north central Mexico, a few of the terminal heads contained filled achenes. Preparations from these, made at the same time and by the same techniques as a number of those of *B. californica*, show a rather similar karyotype. On the whole, the chromosomes appear a little longer in figure 6, but when compared with the earlier stages of that species (see fig. 40), there is not a great deal of difference. However, if the cell is compared with one of almost the same form and size of *B. betonicaefolia*, which has been referred to above as having longer chromosomes, the difference in chromatin content is distinctly noticeable.

The fourth species, *B. Palmeri* Gray, was represented by two collections of the pubescent variety *amphothrix* Robinson from Durango. Their chromosomes seem as identical as their taxonomic characters. However, the karyotype (fig. 13) differs from other species of this subsection. The almost radial arrangement in this cell again shows that long and medium chromosomes are more abundant than the short. Analyses of their types agreed better with many of those of the following subsection. This was not surprising from the taxonomic viewpoint after examining herbarium specimens and seeing seedling plants growing next to those of *B. glomerata* in the greenhouse. Thus we believe cytological evidence strongly supports a different disposition of this species as will be indicated later.

SUBSECTION COLEOSANTHUS. With heads of approximately the same size as those of the previous subsection, Robinson had separated this group of species largely on the basis of leaves. They are given as ovate, lanceolate or elliptical with the cauline ones petiolate, while those of the *Baccharideae* are ovate, rhomboid or suborbicular-reniform and more often small.

The first species, *B. Rusbyi* Gray, is found in New Mexico, southern Arizona, and a little beyond the boundary in northern

Mexico. This was studied in three accessions representing both New Mexico and Arizona and was found to have a complement of chromosomes with those of the shorter length predominating (fig. 2). It is difficult to see that this karyotype varies much from that of *B. californica* or *B. laciniata*, although there may be a more definite break between the four longest chromosomes and the rest. It was not easy to make a final decision in that small realm of difference between medium and short length.

The remaining twenty-three species of this subsection all belong to Mexico and Central America, except the last, *B. floribunda* Gray, which has the same geographic range as *B. Rusbyi*. Other similarities of these two species will be discussed in a later section. While *B. floribunda* was also received from both states, the specimen from New Mexico was immature and thus the karyotype has been seen only in preparations of Arizona material. In numerous cells seen, the open arrangement resulting from short unentangled chromosomes resembles that of *B. Rusbyi*. There were always four longer chromosomes which are not adequately shown in figure 3, because three of them curve out of the plane of focus. In one cell, two of these occurring endwise with one additional short one, occupied the full diameter of the plate. The six short short chromosomes were frequently V-shaped and were considered to have median constrictions. Of the other eight, one pair had possibly submedian and the other three median constrictions. On the whole it is doubtful whether the chromosome set of *B. floribunda* could be distinguished from either that of *B. Rusbyi* of this same subsection or *B. laciniata* and *B. californica* of the previous one. More accessions of it would help confirm or negate the apparent distinctiveness of the four longest members.

In strong contrast are four species from Mexico as well as *B. adenocarpa* from Guatemala and *B. argyrolepis* from Costa Rica. These all have a complement of longer chromosomes. Three figures of *B. glomerata* (figs. 14, 42, 43) have been referred to above as occurring in one and the same Feulgen preparation, the second one showing slightly more condensed chromosomes than the first. The third cell is singular in the unusual amount of contraction involved. It is about equal to that following the paradichlorobenzene treatment of *B. microphylla* (see fig. 35).

Comparisons of these two cells show very little difference. The karyotype as analyzed for *B. microphylla*, 1 Lsm, 1 Lm, 1 Lst, 1 Msm, 2 Mm, 1 Mst, 2 Sm, still remains typical of this species. Quite in agreement with it, are those of *B. secundiflora* (Lag.) Gray var. *secundiflora*, *B. tomentella* Gray and *B. paniculata* (Mill.) Robinson (figs. 20 to 22). Studying *B. secundiflora* and *B. microphylla* on the same day convinces one that it would be impossible to distinguish the karyotypes of these two species. The same types of chromosomes, to the same number, are represented. In cells of *B. argyrolepis* and *B. adenocarpa*, not photographed too well because the chromosomes were long and curved (figs. 28, 27), the longest ones are a pair each of Lsm, Lm, and Lst. Another pair with a submedian constriction came near being as long. Whether they were to be considered Lsm or Msm could not be determined from cell to cell. In the same way there was some indecision about the next to the shortest pair. Were they short or medium? There was this gradation toward greater length, shown in the karyotype by 2 Msm, 1 Sm instead of 1 Msm, 2 Sm of the general karyotype.

A few loose seeds, held in the axillary bracts of several otherwise naked mature heads of a specimen of *B. pacayensis*, collected in March, 1952, by E. Matuda, provided very clear mitotic figures for study. From the many longer chromosomes of which a number are foreshortened in figure 36 and the doubtful category of the second shortest pair, the karyotype is in agreement with those of the two previous species.

SECTION VIII. EUBRICKELLIA.

In four of the species, *B. Wislizeni* Gray, *B. peninsularis* Brandegee, *B. grandiflora* and *B. lanata* (DC) Gray, of which there was sufficient material available, certainly longer chromosomes predominate in all karyotypes (figs. 26, 23, 29 and 19). The same tendency for fewer short chromosomes, as seen in *B. adenocarpa* and *B. argyrolepis*, was seen in the first two of these. Any indecision concerning the two shortest pairs was dispelled in *B. grandiflora*. In this species they were medium; there were none equivalent to the short of the general karyotype. This species most nearly resembled that of the following section. The complement of *B. lanata* did not conform with the others.

It compared rather with cells of species of the previous subsections having the general karyotype. Though four different cells were photographed, none varied to longer chromosomes. Figure 49 of a second cell again compares favorably with those of species of earlier sections on the plate.

In one cell of a Feulgen preparation of *B. Wislizeni*, it was found that the tip of the short arm of a long chromosome (fig. 46, upper left) appeared very pale, though not distinctly separated from it as was the satellite of *B. Coulteri* (cf. figs. 12, 37, 38). When compared with the latter, however, it seems probable that one of the same long subterminal chromosomes is involved as are those which bear the satellites. Since there was this single instance of such terminal differentiation, *B. Wislizeni* cannot at present be considered to include chromosomes with satellites.

Of the fifth species, *B. incana* Gray, two accessions were compared, and in both the chromosomes were predominantly short. In the first, a very clear plate of well-separated units seen under the microscope, includes no chromosomes which could be classed as long, but rather medium, short and short short ones (fig. 9). In a similar Newton Gentian Violet preparation of *B. incana II*, it was seen that there was a small terminal satellite-like body on one of the longest, an Mst chromosome. In the strongly contrasted print of the karyotype (fig. 47), it appears at the upper left rather more prominently than it really is. In a second figure (fig. 48), a pair of chromosomes, each with this small satellite, is shown at the lower right although the rest of the plate was not clearly in focus. Once recognized, it was possible to find evidence of them in other cells so that one felt satisfied there was actually no difference in these two accessions of the species. In examining plates of more condensed chromosomes only, the small trabants could easily be missed. Comparisons with previous figures show them to be less well defined and smaller than the satellites of *B. Coulteri*.

(*to be continued*)

Additional Notes on Grasses of Boone County, Missouri. —During the past two seasons, a number of previously unreported species of grasses have been observed in Boone County in central Missouri. The several publications relating to the local flora have been reviewed in ascertaining unreported species, Daniels (1907), Rickett (1931), Bush (1931), Drouet and Jeffry (1934), Drouet (1935), and Drew (1942). In addition, the University herbarium was surveyed for any specimens collected in the county, but which hitherto had not been reported.

Following is a report on several species occurring in the county.

Diplachne fascicularis (Lam.) Beauv. A representative collection was made from wet margin of natural sinkhole ponds occurring on high ground near Missouri River at Rocheport, T48N, R14N, SE ¼ sect. 17. Coll. 730, October 22, 1952. Listed by Palmer and Steyermark for adjacent Randolph County and several other counties in central Missouri.

Triodia stricta (Nutt.) Benth. Several dense stands occur on moist open ground six miles east of Columbia, T48N, R12W, sect. 12. Coll. 650, September 25, 1952. Known from southeast Missouri.

Sphenopholis intermedia Rydb. This species is common, listed by Rickett as *S. pallens* (Spreng.) Scribn. of Gray's Manual, ed. 7, however, not *S. pallens* (Biehler) Scribn. of ed. 8 which does not occur here.

Muhlenbergia frondosa, f. commutata (Scribn.) Fern. This form was found on moist ground of large impoundment approximately eight miles south of Columbia, T47N, R12W, sect. 26. Coll. 515, August 2, 1952.

Phalaris arundinacea L. This introduced perennial occurs sparingly in the county, in erosion control plantings and on dam sites. Representative collection was obtained from pond on University Farm. Coll. 429, August 17, 1951.

Anthoxanthum odoratum L. This species is well established on grounds near University greenhouses. Coll. 301, May 6, 1951. Specimens collected in 1944 from same general location by Maneval. It has been found since on low ground of a stream branch south of Columbia, May 8, 1953.

Paspalum pubiflorum, var. glabrum Vasey. This variety was collected on moist ground along shaded roadside near Missouri River at Providence, T47N, R13W, SW ¼ sect. 20. Coll. 695, October 10, 1952. Several specimens in herbarium collected outside the county as *P. laeviglume* Scribn. of ed. 7.

Setaria Faberi Herrm. This adventive is becoming more common and perhaps has been present for some time, occurring in cultivated fields and waste ground. Coll. 400, August, 1951.

Andropogon Elliottii Chapm. A representative specimen was brought in from an old field one mile west of Columbia, T48N, R13W, sect. 15, and probably marks its most northerly distribution in this portion

of Missouri. This species also occurs on the University Arboretum approximately 18 miles south of Columbia, T46N, R11W, sect. 29, having been found several years earlier by Livingston.

Andropogon saccharoides Sw. This species previously known from southwest Missouri was observed along the M-K-T Railroad near Providence, T47N, R14W, sect. 20, 28. Coll. 721, October 15, 1952.—C. L. Kucera, department of botany, university of missouri.

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Plants Recently Found in Southern Illinois.—During recent field work in southern Illinois two plants which are new to the State have been discovered. Two others recognized as rare have been found and extend the range within the State. The plants and collection data follow:

Cyperus filicinus Vahl., a single specimen, was found in a roadside depression near the village of De Soto, Ill. This species is known mostly from along the Atlantic and Gulf Coast. As given in Gray's Manual, 8th edition, the range is "rarely fresh pond-shores, Fla. to La., n. to s. Me." The Illinois station would seem to be an extension of range to the midwest.

The material was checked by G. D. Fuller of the herbarium of the Illinois State Museum. Dr. Julian Steyermark has also verified the determination. The material was divided and deposited in the herbarium of the Illinois State Museum, Springfield, and in the Herbarium of Southern Illinois University, Carbondale. *J. W. Voigt 391.*

Allium mutabile Michx., was found in considerable abundance on the top of a sandstone bluff and in the niches of exposed sandstone at the roadside near Trigg (forest lookout) Tower in Johnson County. This plant has been reported both from south-

ern Indiana and Missouri, but not previously from Illinois. Specimens are deposited in the following herbaria: Illinois State Museum (Springfield) Natural History Survey (Urbana), and Southern Illinois University, Carbondale, *J. W. Voigt 1109* (with J. R. Swayne).

Isoetes engelmanni A. Br., was found on several sandstone bluffs at Giant City State Park in Jackson County. The habitat was a shallow depression which was kept continually wet by seepage. This species is previously known in Illinois only from St. Clair County.[1] The specimens collected were deposited in the same herbaria mentioned for the preceding species. *J. W. Voigt 1320.*

Phacelia ranunculacea (Nutt) Constance, was found at the Pine Hills area in Union County near the edge of a swamp. It seems that this plant (collected as *J. W. Voigt 1037*) has not been found previously in Union County.—J. W. Voigt, Southern Illinois University, Carbondale.

Erroneous Record of Diplotaxis erucoides from Western United States.—The only published record of *Diplotaxis erucoides* (L.) DC. from western United States is apparently that by P. C. Standley in his "Flora of Glacier National Park, Montana" (Contr. U. S. Nat. Herb. 22: 347. 1921). Standley reported it from along the railroad at the eastern entrance of the Park, and added: "This species is of rare occurrence in the United States, and it is not reported in any of the manuals. It seems to be fairly well established at this locality." The specimen which is the basis of the record is *Standley* 15666 in the U. S. National Herbarium, labeled as collected on railroad bank in vicinity of Glacier Park station, 15 Aug. 1919, and consists of two stems in flower and fruit. The record was repeated in the second edition of Rydberg's Flora of the Rocky Mountains and Adjacent Plains (p. 1122. 1922) with a description which applies to the species properly so called. Standley's plant, however, has a comparatively slender subterete beak to the fruit, discoid not obviously sulcate stigma, and narrow pods 1–1.5 mm. wide with the seeds definitely in a single row, and is in fact *Erucastrum gallicum*

[1] Jones, G. N. 1950. Flora of Illinois, 2nd. ed. University of Notre Dame Press, Notre Dame, Indiana.

(Willd.) O. E. Schulz. The true *Diplotaxis erucoides* has a distinctly flattened beak nearly as wide as the body of the fruit, the stigma rather conspicuously 2-lobed by a shallow sulcus, and the seeds definitely 2-ranked, and there are other differences in the size and color of the petals, pubescence of the calyx, and so on.

In the National Herbarium there are other specimens from Ohio and Alberta misidentified as *D. erucoides*, evidently on the basis of comparison with Standley's specimen, but it appears that none of these has been reported in print; there is also a specimen of the collection actually of this species made in Quebec by Collins and others in 1904, mentioned just below. In the 8th edition of Gray's Manual (1950) *Diplotaxis erucoides* is reported only from Gaspé County, Quebec, which appears to be the single area in North America in which it has made more than a casual appearance. Specimens are in the Gray Herbarium from York, Gaspé County, collected on ballast about fish houses by J. F. Collins, M. L. Fernald, and A. S. Pease on 25 Aug. 1904 (and said to be very abundant), and again the following year (27 July 1905) at the same locality by E. F. Williams, Collins, and Fernald; there is also a specimen collected by Addison Brown on ballast near Communipaw Ferry, New Jersey [present site of Jersey City, Hudson County], in Sept. 1880 (information supplied by C. Earle Smith). In the herbarium of the New York Botanical Garden are specimens collected at Communipaw Ferry by Brown in Sept. 1880 and June 1881, as well as one collected on ballast at Arlington, Staten Island, New York, 20 Sept. 1908, by Arthur Hollick (information supplied by D. D. Keck and J. Monachino, and Hollick specimen borrowed for examination). The herbarium of the Philadelphia Academy, as Mr. Bayard Long informs me, contains no additional material.

Standley's collection of *Erucastrum gallicum* appears to be the first and only one so far made in Montana. In the eighth edition of Gray's Manual (1950), Fernald reported it from Newfoundland and Nova Scotia to British Columbia, south to Pennsylvania, West Virginia, Indiana, Missouri, South Dakota, etc., rapidly spreading. In Abrams' Illustrated Flora of the Pacific States (2: 274. 1944) it is given as locally introduced in Santa Clara County, California.—S. F. Blake, Division of Plant Exploration and Introduction, U. S. D. A., Beltsville, Md.

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Vol. 55 **October, 1953** **No. 658**

FURTHER LIGHT ON AARON YOUNG JR'S FLORA OF MAINE

Ralph C. Bean

In 1935, Mr. Arthur H. Norton reviewed the life of Aaron Young Jr. and related what he could find about his botanical survey of Maine. He told of the "Flora of Maine" of which only the first volume ever appeared. At that time Mr. Norton stated that "no copy in the original condition seems to be known in existence today." Recently a copy of this "Flora" has come to light in a rather dramatic fashion. In the summer of 1951 an excellent copy of this "Flora" was purchased in Antwerp and brought back to this country and presented to Miss Adelaide Pearson of Blue Hill, Maine. Realizing that this book was of real value to students of our New England flora, Miss Pearson presented it to the Gray Herbarium on December 5, 1951.

This volume of the "Flora of Maine" has been examined with interest and some description of it seems worth while. It is 20 x 14 inches over all and the leaves are 19½ x 13½ inches. It is bound in cloth with board covers. The first page contains the following: "Flora of Maine, illustrated with specimens from nature, arranged according to the natural system and containing descriptions of all the known indigenous plants growing in the State, giving their generic and specific characters, principal synonyms, places of growth, and time of flowering and occasional remarks, by Aaron Young Jr., Bangor, Samuel S. Smith, Printers, 1848."

In the preface Dr. Young states: "This volume which may be considered as a sample, is now presented, with the flattering hope, that a generous allowance will be made for its unavoidable imperfections, and that it will be accepted (as it is really intended)

as an exhibition of our native wilds; perhaps in future years to display and relate the history of some surviving remnants of Flora, now so universally disseminated."

"The work will be issued in volumes of the present magnificent size, of which, only a few limited number of copies will be obtainable by subscribers. It will consist of about twenty volumes, the last of which, will contain a copious index, embracing, in separate columns, the common and scientific names of each plant."

He continues: "In May 1847 I memorialized the Legislature to that effect, urging that body for an annual appropriation of five hundred dollars for three years, to enable me to make such researches as were deemed necessary, for the accomplishment of the above object. The result is well-known, and although the actual amount requested was reduced to less than half, I have still felt strongly encouraged in the undertaking, and have labored with no small degree of enthusiasm, in the prosecution of the Survey, and in the preparation of an historical herbarium, a work which may justly be conceived as certainly more suitable for the State than the common method from which this very essentially differs."

In spite of this enthusiastic proposal only the first volume was ever published and until this present copy appeared, it had apparently disappeared completely. In the published volume sheets 13½ x 27 inches are folded and bound to make up the book. The first page contains the name of the plant, remarks as to the time of flowering, uses and often quotations from various authors such as Bigelow, Dewey, Torrey and Emerson whose "Trees and Shrubs of Massachusetts" had been published earlier. On the second page is pasted the actual specimen with its name. The volume is inter-leaved with thin paper.

It is interesting to note that this "Flora" was published the same year in which Gray's Manual first appeared. Jacob Bigelow's "Florula Bostoniensis" had appeared in 1814 in the first edition and Alfonso Wood published his first "Classbook of Botany" in 1845, only two years before the Survey. Of course Gray's Manual was unavailable at that time and apparently Young used Torrey for his authority.

The following is the list of species included in the volume given in the order in which they occur. It is not easy to understand

why just these particular species were selected for inclusion. There are thirty-nine species on thirty-three pages. These include: *Aster acuminatus, A. cordifolius, Polygala paucifolia, P. polygama, Antennaria margaritacea, A. plantaginifolia, Apocynum androsaemifolium, Acer pennsylvanicum* [*A. striatum*], *Urtica canadensis, Elodea virginica, Anemone nemorosa, Lobelia cardinalis, Tiarella cordifolia, Lonicera ciliata, Betula nana, B. papyracea,* var. *minor, Aralia nudicaulis, Empetrum nigrum, Acer spicatum, Cornus canadensis, Cerasus pennsylvanica* [*Prunus borealis*], *Trillium erythrocarpum* [*T. pictum*], *T. erectum, Chiogenes hispidula, Ledum latifolium, Vaccinium uliginosum, V. Vitis-Idaea, Pyrola rotundifolia, P. unifolia, P. secunda, Calopogon pulchellus, Orchis orbiculata, Melampyrum americanum, Uvularia sessilifolia, Asarum canadense, Lycopodium clavatum, L. Selago, L. lucidulum* and *L. dendroideum.* The names are as he gave them and some of them seem strange to us today, a hundred years after.

In a foot-note in Mr. Norton's article he stated that "Dr. M. L. Fernald informs the writer that there is a set in the Gray Herbarium which has been taken apart and the specimens distributed according to the classification of the Herbarium." I have been unable to find evidence of sheets from this "Flora" in the Gray Herbarium. I have found various specimens collected by Aaron Young Jr. in the Herbarium but with definite labels. They were originally mounted on a light blue sheet and evidently with more than one species to the sheet. So what you now see is a part of one of those blue sheets cut off and pasted to a regular herbarium sheet and with its own label. These labels usually contain the following printed matter: "Botanical Survey of Maine, Mt. Katahdin, Lat. 45° 97′, Lon, 69° 30′ west, Obs. Elevation above the Sea —, Collected Aug. 1847, A. Young Jr." A few specimens were found that were collected in some other section of Maine. A search in the Gray Herbarium for specimens of the species found in the "Flora" revealed only a small fraction of them. Using a list of Mt. Katahdin plants a search resulted in finding only a very small number of the species of that area. Among these plants were *Arenaria groenlandica, Rhododendron lapponicum, Brianthus taxiflorus* [*Phyllodoce caerulea*], *Cassiope hypnoides* and *Vaccinium uliginosum.*

In the "Flora" itself no data is given for the particular specimens except that in the case of eleven of them Mt. Katahdin is cited. In looking up material on Aaron Young Jr. in Rhodora I found in a survey of the various herbaria in New England by Miss Day, at that time Librarian of the Gray Herbarium, an article in which she stated in regard to the Herbarium at Bates College: "The nucleus of this herbarium was gathered many years ago by the late Dr. Aaron Young Jr." On a recent visit to the Bates Herbarium through the courtesy of Dr. William H. Sawyer Jr. head of the Botany Department, a search was made for Young specimens. What was found were apparently sheets from Volume 1 of Young's "Flora." These sheets had evidently never been bound into a book and had been distributed into their proper place in the Herbarium. There was no identifying mark either of the collector or place of collection or of the date.

This "Flora" is of considerable importance in the history of Maine botany but a number of more exhaustive collections have been made on Mt. Katahdin. As Prof. Fernald (1901) says in Rhodora "Though they brought back the first representative collection of Katahdin plants, they apparently got none of the rarer species, and the data on their labels are unfortunately incomplete."—Wakefield, Massachusetts.

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CHROMOSOME STUDIES IN KUHNIINAE (EUPATORIEAE). I. BRICKELLIA

L. O. Gaiser

(*Continued from p. 288*)

Seeds of the northerly species *B. Greenei* Gray, which has a limited distribution in northern California and Oregon, have been recently received. In figure 41 of a large periblem cell, where the chromosomes overlap hardly at all, their sizes as well as the spaces between them indicate the absence of any long ones. At least four central ones are medium in length and the remainder are short, two pairs at least short short. Though it was out of focus for the photograph of the inner tip of the medium chromosome seen at center bottom, there is a small satellite. In another cell, there were two such chromosomes (fig. 46), outer, lower and upper left. By the presence of this pair, as well as the lack of any long chromosomes, the karyotype of this species more nearly resembles that of *B. incana* (cf. figs. 47, 48) than any other. By a comparison with those of figures 1 to 30 it is apparent that by the lengths of the chromosomes it would have to be placed within the second row before those of the *Microphyllae*, which have been referred to as a general karyotype.

Of the two species, *B. oblongifolia* var. *linifolia* and *B. macromera*, not enough dividing cells were seen to permit karyotypic analysis or to select adequate ones for photography. Nevertheless, besides enabling accurate counts in both, the figure of *B. oblongifolia* justifies the statement that its karyotype is more similar to those with longer chromosomes than to *B. incana* with a complement of short units. *B. macromera* appeared to be more like *B. californica*.

SECTION IX. MACROBRICKELLIA.

This section represents the ultimate size of the head in the genus, as many as one hundred and thirty-eight florets having been counted in a head of the specimen received. *B. monocephala*, in the first preparations of inactive tissues, gave evidence of comparatively large nuclei, being almost twice the size of those in *B. diffusa*, which was being studied at the same time. When seen, this karyotype clearly consisted of longer chromo-

somes than any other examined (fig. 30). The two shortest pairs were well equal to what were classed as medium ones elsewhere and proportionately, the medium and long chromosomes were longer than in others. In the figure are seen across the top, three of the long submedian class with the shorter arm of one a little blurred by the overlying long median one. The two on either end are a pair, while the mate to the middle chromosome, clearly in focus at center right, emphasizes that these two pairs of heterobrachial chromosomes show different proportions in length of arms. Though one would hardly call this latter pair subterminally constricted, it is quite possible that reduction in total length of this chromosome would result in about the equivalent of an Lst of other karyotypes. In the row of four chromosomes of medium length at center left, can be seen in succession 1 Mm, 1 Mst, 1 Msm, 1 Mst, respectively. Completing all the classes of this karyotype, the shortest length is seen in one just next to the long submedian one at the right. With a little attention, each of the classes can be seen in this cell without resorting to stylized idiograms.

SUMMARY ON KARYOTYPES

In the thirty-three perennial herbs and shrubs carefully examined, there is one chromosomal complement, or a complement so closely approaching it that it cannot be distinguished, common to fifteen species. This has been called the general karyotype since it involves the greatest number of species. It is represented, approximately in the order of the lengths of the chromosomes, as 1 Lsm, 1 Lm, 1 Lst, 1 Msm, 2 Mm, 1 Mst, 2 Sm. Since so many species did not differ recognizably in the morphology of their chromosomes, it is concluded that speciation is in a large measure due to genic changes.

Quite distinctive karyotypes were found, however, in:

(1) The predominantly short chromosomes of *B. laciniata*, *B. desertorum*, *B. californica*, and the nearly as short ones of *B. veronicaefolia*.

(2) Similar to (1), the almost indistinguishable karyotypes of *B. Rusbyi* and *B. floribunda*.

(3) The distinctive complement of short chromosomes, with one pair showing satellites, of *B. incana* and *B. Greenei*.

(4) *B. Coulteri*, similar to the general complement, but with one pair having satellites.

(5) The singular complement of entirely long and medium chromosomes, longer than in other species, and lacking any short ones, of *B. monocephala*.

(6) *B. grandiflora*, with long and medium chromosomes only.

(7) The fewer short (one pair rather than two) in the complement of predominantly longer ones, of *B. Wislizeni*, *B. peninsularis*, *B. argyrolepis*, *B. adenocarpa*, *B. pacayensis*, and also in *B. betonicaefolia* and *B. amplexicaulis*.

A little less striking but real, the tendency of all-around shorter chromosomes in *B. dentata* of the *Parvulae*.

There are included in the first three categories (involving eight species), evidences of a smaller amount of chromatin in the much shorter chromosomes, than in what is here referred to as the general complement. In the last three categories (nine species), the evidence for longer and fewer short chromosomes amounts to a greater total of chromatin material than in that of the general karyotype. The additive effect in these two groupings increases the difference in the extremes of karyotypes found within the perennials.

The karyotype of only one annual was seen and that distinctly falls in with those of lesser chromatin content having chromosomes of reduced length.

Meiotic Studies

observations

It has been possible thus far to see the meiotic chromosomes in twenty-six accessions[8] of twenty-one species. Among these, there is a representation of each section and subsection of which the karyotype had been studied, except for the first and last sections, and of subsection *Brachiatae* to which *B. Coulteri* belongs. *B. diffusa* and *B. monocephala* would have made interesting additions to confirm the differences in their chromosome sizes, seen in somatic figures. *B. scoparia*, subsection *Clavigera*, was additional, as in it mitosis has not been seen.

[8] Material of additional accessions of some species has been collected but the suitable meiotic stages have not as yet been found in them.

Fixed preparations, in which the size of units could be suitably compared because of the uniformity with which the field material was treated, showed quite similar plates of 9 chromosomes. In those of *B. veronicaefolia* varieties *veronicaefolia* and *senilis*, the first and second metaphase plates appeared smaller than others, but due to unfavorable staining were not photographed. They were not so large as those of *B. scoparia* (fig. 50) which are perhaps a trifle smaller than those of *B. verbenacea* and *B. glomerata* (figs. 51, 53), both species having the general karyotype. None of the other species having complements of the smaller chromosomes were collected in Mexico and so are not included. However, a cell of *B. californica I*, from an acetocarmine smear of pollen mother cells, is shown in figure 56. Although by that technique, chromosomes are invariably swollen so that they appear larger than in fixed preparations, these are certainly no larger than those of *B. scoparia*. The other haploid counts had been obtained by means of smears, but slides of only a few were kept.

As the number of florets per head varies from eight (e. g., in *B. scoparia*) upwards, there is frequently an unusual variety of both first and second[9] division stages even in sections of heads that have been cut at time of fixation to allow better infiltration of fluids. Successful fixation, without shrinkage, resulted in heads numbering up to twenty-seven florets, which had been left uncut. Meiosis was found to proceed regularly except in a single collection of each of two species, *B. reticulata* and *B. pendula;* in one of two collections examined of a third species, *B. glomerata;* and in one of three collections of a fourth, *B. adenocarpa*. In preparations of *B. glomerata I*, very regular metaphase plates were seen (fig. 53). In contrast, such could not be found in *B. glomerata V*, for at best one or two units were on a different focal level. In lateral anaphases and telophases, chromatin bridges were at once evident (fig. 54, 55). In the latter figure, a tiny unit was divided late and probably represents the fragment of an inversion. In *B. adenocarpa Ia*, there were found in anthers of the same floret, regular metaphase plates as in figure 59, and also two cells in early telophase, each with two very similar belated chromosomes approaching the

[9] Hereafter first and second division stages will be referred to as I and II respectively.

[10] In conversation with the late Prof. Conzatti, he stated this species was very difficult to find.

poles. In one of the cells (fig. 60), it can be seen that the laggards are approximately the same size as the chromosomes which had already reached the poles. Attached to the one at the bottom is a small fragment, probably again that of an inversion. Careful examination of the sections showed many regular I and II metaphase and telophase stages but occasionally there was evidence of one or two bivalents splitting earlier on the plate.

Preparations of *B. reticulata* offered a strong contrast to those of closely related *B. oliganthes* and *B. verbenacea* (fig. 51) the materials of which had also been collected in Mexico. Meiosis proceeded regularly in the two latter, and in *B. venosa* from Arizona in addition, while in *B. reticulata* all plates of I metaphase were slightly irregular. When seen laterally all of the chromosomes but one (fig. 52) or two were in a neat median line as though one or two bivalents had not been organized in the plate. In *B. pendula III*, the same kinds of disturbances were found; one outlying unit on lateral metaphases (fig. 58), less frequently two, and occasional telophases showing division of lagging units. In one cell, each of two univalents was dividing evenly, one on mid-spindle and the other close to one pole (fig. 57).

DISCUSSION

Just how abundantly such irregularities occur in this genus is still a question. One of the four referred to here, was collected in the field in Guatemala and the other three, in Mexico on three different dates in as many different states. The incidence among the more southern species seems of a rather high proportion, 4 out of 13, when compared to smears from greenhouse plants of an equal number of other species, where no irregularities were noticed.

Irregularities in meiosis of the kinds described are usually associated with structural hybridity, indicating that inversions have taken place. They are well known in interspecific hybrids and are also found in a number of species (Darlington, 1937, and Dobzhansky, 1941). Various species of *Paeonia* (Dark, 1936; Stebbins, 1938) are especially remarkable in that all individuals studied gave evidence of one or more inversions. The species of *Brickellia* affected, belong principally to the subsection *Coleosanthus*, although one is of the *Reticulatae*. The observations bring up very interesting points in relation to these species.

Discussion of *B. reticulata* (Gaiser, 1952) explains the doubt concerning this entity. Both Gray (1852) and Robinson (1917) had suggested that it might not be distinct from *B. oliganthes*. In this author's collections, from two different localities in the adjoining states of Michoacán and Jalisco specimens were found which come within the descriptions of *B. oliganthes* and *B. verbenacea* respectively, and from Morelos, this one plant of *B. reticulata*. They are clearly closely related, but cytologically the latter has been found to differ from the other two. If the meiotic irregularities seen are merely indicative of structural changes, such as inversions, it is generally considered that such have no effect on the phenotype but to alter gene linkage and introduce sterility (Gates, 1951). Although seeds were obtained from the first two specimens, it is not known whether this single plant of *B. reticulata* would have been fertile since it was in an early flowering stage. By the tomentose stems with numerous almost entire leaves it was recognized as differing from the other two species, and strongly resembling the figure of a single plant of Haenke's, which DeCandolle described as *B. reticulata*. Like it, the plant was robust and the inflorescence was large, characteristics that might be indicative of hybrid vigor. It may be that the chromosome behavior is the result of two not quite compatible genomes and that this plant represents some midform between a species with the somewhat serrate leaves, as seen in *B. oliganthes*, and another even less closely related species. At least three other species were collected within a stretch of seven kilometers on the same road from Cuernavaca to Jautepec, *B. glomerata III*, *B. paniculata*, and *B. scoparia*. Of these, the former was very abundant and grew close by the plant of *B. reticulata*. In material collected from *B. glomerata III*, the pollen had already developed and the grains were regular in form.

Of *B. glomerata*, it was possible to study meiosis in materials of the two accessions, I and V, collected respectively in Cuernavaca and from near Taxco. The first accession which had normal divisions with regular plates, had been noticed to vary in height and size of leaf from *B. glomerata II*, which was also collected along the river bank in Cuernavaca. From an examination of the Taxco specimen, collected in early flowering condition from a high exposed and sunny rock, the characters of leaves

and heads seemed to come within the description of the species. This was also true of specimens from three other shrubs, taken near by, which were not in such advanced conditions, but varied considerably in height. In that region of Taxco, a sharp lookout was kept for the closely related species *B. hebecarpa* (DC.) Gray, from which it had been separated and which had been reported from Puenta de Ixtla, less than 50 kms. distant. Leaves which are basally acute rather than rounded, and heads pedicellate rather than glomerate, should distinguish the two species. While some of the material of *B. glomerata* had leaves that bore a resemblance to that species, none was found in this early stage with other than sessile heads. One is led to wonder if, with many more collections, these characters might fail as clear cut specific delimitations.

The accession of *B. pendula III* with lagging bivalents in meiosis, was found in Puebla, on the route from Jalapa to Puebla, on open scantily wooded slopes intermingled with shrubs of *B. veronicaefolia.* At the time of collection it was left unnamed. In part this can be explained by the uncertainty of distinguishing the species *B. secundiflora* var. *secundiflora* and *B. pendula* in the field. It is similar to two other collections made in Mexico, D. F. and Puebla, respectively. In comparison with specimens in the herbarium, this collection resembles *B. pendula* in its oblong-lanceolate leaves and the presence of reddish stipitate glands on the pedicels and phyllaries. It does have more flowers per head than is given by Robinson, 19 rather than ca. 12. In this it is more nearly like *B. secundiflora* with ca. 20 flowers.

The material of *B. adenocarpa Ia*, generally characterized by very normal divisions, showed in the anthers of one floret, chromosome bridges and regular first metaphase plates. The specimens of this accession were identified as variety *glandulipes*, having some glandular as well as some non-glandular trichomes on the pedicels and phyllaries. A few plants were found with first flowers which were yellow, establishing the species, which by herbage alone might have been confused with *B. paniculata*, of rosy pink flowers. *B. adenocarpa* var. *adenocarpa*, which lacks the glandular trichomes and has soft hairs instead, was not found along with it at this station. However, it is known to

occur in the vicinity of Antigua, a little of it having been sent in dried condition, from the region where material of the fifth accession was taken. However, as there was no cytological fixation of it, there has been no examination of the variety distinctly lacking glandular trichomes.

All four species, in which the irregularities have been found, certainly raise critical questions. Is *B. reticulata* separated by significant isolation barriers from *B. oliganthes?* The same question arises concerning *B. glomerata V* in relation to *B. hebecarpa. B. pendula III* did not completely satisfy the species-description, comparing favorably with the closely allied *B. secundiflora* in number of florets per head. *B. adenocarpa* var. *glandulipes Ia* represents a transition between non-glandular and glandular pubescence. Since the same intermediacy occurs in two other species, *B. secundiflora* and *B. Palmeri,* where the same intergrading pairs were made varieties, this may be of less significance.

Stebbins has observed in species of *Paeonia* that, in those including a number of geographical races, the evidence for inversions was greater than in more uniform species. Certainly such a species as *B. scoparia,* studied from the same kind of preparations and regular in meiosis, is a very uniform species as found by the writer in Oaxaca, Michoacán, and Morelos. Once seen, *B. veronicaefolia,* although divided into four varieties by its pubescence, would always be recognized. In two of these varieties examined meiotically, it was perfectly regular. Looking over the list studied by smears from *B. microphylla* to *B. grandiflora,* few if any would be called large polymorphic species.

The greatest trouble seems to lie in subsection *Coleosanthus,* which with 22 species, is the largest. If the two species, *B. Rusbyi* and *B. floribunda,* from the New Mexico and Arizona region, are excepted, all the rest are fairly close Mexican and Guatemalan congeners. Without questioning the equivalence of species or races in different genera, it may be that this group is in a great state of flux, with more variations arising.

That there may be intermediates among a group of such closely related species, was recognized by Robinson (p. 83). A note after *B. secundiflora* refers to one specimen which he considered intermediate between that species and *tomentella.* It may be significant, that in collections concerning which there was no

doubt as to identity, as the broader-leaved variety *nepetaefolia* of *B. secundiflora,* with strictly non-glandular trichomes, and *B. tomentella,* from the entrance to the valley of Orizaba, no disturbances of meiosis were found.

Trichomes

A study of leaves of the species of *Brickellia* which had been examined karyologically was begun to see if there were any correlations between the kinds of trichomes and their types of chromosomal complements. Since there was a splendid representation of this genus in the Gray Herbarium, a similar examination of most of the species was undertaken in case they might be of any further aid in taxonomic classification. Thus leaves were cleared of all but six species which were only scantily represented. As far as possible, leaves were chosen from annotated sheets mentioned in the monograph so that those studied would be of specimens close to the types.

At the outset, absence or presence of trichomes is not considered significant. From the experimental studies of Clausen, Keck and Hiesey (1940) on other genera of the *Compositae,* it was established that the amount of pubescence was one of the most easily modified characteristics in transplant experiments, but the type altered hardly at all. This suggests, in some genera perhaps, a promising use of the nature of the trichome in distinction of species.

The trichomes found in the majority of the species were multicellular and unseriate, the first class given by Metcalfe and Chalk (1950, p. 783) as common in the *Compositae.* The length of the cells in these may vary. When they are short and rather block-like, as in *B. betonicaefolia* (fig. 61), trichomes have here been called attenuate. A few very similar trichomes were found along the veins of *B. amplexicaulis,* the closely related species, which has a great predominance of glandular trichomes. The side walls of the attenuate type were generally very straight due to the greater support of the cross walls, as in the rungs of a ladder. In contrast, those with more distant septations and longer cells frequently had a slightly wavy outline due to a little narrowing in the middle diameter of the cells, which might have partly resulted from the treatment. This type looked rather

"icicle-like" and will be termed long acuminate (*B. paniculata*, fig. 62), in contrast to attenuate. But the two are not sharply limited, *B. secundiflora* seeming to be intermediate between them. Trichomes of these two types were but one cell in diameter throughout their entire length, including the stalk cell. The latter was usually large and undifferentiated, frequently covering parts of more than one epidermal cell. Of course the total length varied considerably on any leaf, but on leaves of species described by Robinson as puberulent, the general length was short in comparison with the longer trichomes of the pubescent species. Such shorter trichomes were always more nearly similar and more difficult to place in either one or the other of these two classes. Illustrations are included of one of annual *B. diffusa* (fig. 63) where the leaf was described as sparsely puberulent or glabrous and of *B. monocephala* (fig. 64) similarly called puberulent. There were also variations in the thickness of the wall which helped to account for the firmness of those on so-called scabroid leaves. The cells of these were usually isodiametric and sometimes built on a base of several cells (*B. scabra*, fig. 65).

Of course on some leaves the indumentum was of erect or unbent trichomes, whereas others were appressed in varying degrees, and some of the longer ones were even somewhat coiled. Generally this did not alter the type. However, little variations were noted affecting the terminal cell or cells which appeared to be somewhat transitional to the next form to be described. *B. Palmeri*, of which a long and a short trichome were drawn *in situ* (fig. 66 and 66a), serves as an example, as might also *B. glomerata*. Similarly throughout the *Reticulatae*, a long acuminate type with a tendency towards a cap cell, is found consistently, although there are variations in the length and diameter of the trichome in the seven species (fig. 67, *B. reticulata*).

The most extreme form with terminal differentiation, represented in *B. veronicaefolia*, had the appearance of a terminal cap cell and is here referred to as "towards cap." Although not nearly as distinctive as those of Guayule shown by Rollins (1944), they have a definite tendency in that direction. Fig. 68 represents three trichomes drawn *in situ* from the surface of a leaf of *B. veronicaefolia* var. *veronicaefolia* showing that even in the

shortest ones, whether erect or bent, the terminal cells are differentiated. This variety was described as very short pubescent. Furthermore on the leaf of variety *senilis* of this species, which was described as tomentose, the trichomes, although much longer, show a similar tendency towards cap cell (fig. 69). In this type the long side walls appear less strict due to a little more protruding in the proximal cell width.

What appears to be a modification from the attenuate type, has distinctly rounded rather than straight side walls, which give a bead-like appearance (*B. californica*, fig. 70). Almost always the longer hairs of this type were two cells wide at the base and sometimes through the proximal and antiproximal cells as well. This has been called moniliform here, which implies a more restricted use of the term than in Robinson's treatment where it applied also to *B. veronicaefolia* var. *senilis* described above. While one hesitates to classify shorter hairs as of any particular type, in *B. Rusbyi* (fig. 71) there is a strong suggestion of the moniliform. The longer trichomes along the mid-rib of the leaf of this species definitely resemble *B. californica* in their double basal cells as well as general contour. The type seems distinctive even in the very short ones, occurring very sparsely on the almost glabrous leaves of *B. laciniata* (fig. 72). Comparisons with figures of the other short puberulous ones emphasize this.

The thin-walled, much appressed trichomes of *B. dentata* differ from the other types in tapering less from base to tip and having even the apical cells rounded. Also they are narrower at the cross walls rather than at mid-diameter of the cell. It was not easy to follow one throughout its entire length as many were broken in the preparation. Two parts have been drawn here, one of the basal and wider cells (fig. 73) and the other of longer ones, characteristic of the tip (fig. 73a). No trichomes were found extending from the margin of this leaf. In no other species studied karyologically is there a match for this. Even among those in which the chromosomal complement has not been examined, no very close approximation was found. Leaves of two other species in the same subsection are either glabrous, as in *B. brachyphylla*, or scabroid puberulous as in *B. parvula* Gray. In the third species, *B. cylindracea* Gray, the trichomes are not extremely long either but are of the long acuminate type.

The most distinctive variation was the long thin-walled, almost entirely non-septate trichome which was found only in *B. incana.* Under the microscope, these seemed indefinite in length and there was difficulty finding the tip and base on the same one. Thus a comparatively short one, which came within the microscopic field, was drawn (fig. 74). While it shows one cross-wall, this was seen infrequently. In the majority none at all were found. A very rare instance of branching above the cross wall of the single stalk cell is represented in figure 74a. These long interwoven hairs easily form the matted condition for which the species is named. On the other hand, the "woolly" appearance for which DeCandolle named *B. lanata,* consists of very long hairs of the long acuminate type (fig. 75). Comparison of the trichomes of these two species which rank among the longest found in the genus, show those of *incana* to be exceptional not only in length and almost complete lack of septation, but also in the slight indication of branching.

In the section on the *Compositae,* Solereder (1899) described a kind of non-glandular trichome, consisting of a uniseriate pedestal with a long whip-like terminal cell and included an illustration (Fig. 103B) from Vesque (1885 Pl. 10 Fig. 5) for *Cirsium lanceolatum* Scop. In the addenda (Solereder 1908, p. 954), in a longer list of genera to which this type is said to be common, *Brickellia* is included without reference to any species. Metcalfe and Chalk *l. c.* referring to the same figure, give this as their second class of non-glandular trichomes in the *Compositae.* In our studies of *Brickellia,* the trichomes of *B. incana* would come nearest to qualifying for this type. It is, however, more comparable to figure 6, Pl. 10 (Vesque, *l. c.*) of *Antennaria plantaginea,* or figures 17 and 18 by Volkens (1887) for *Echinops spinosus* and *Atractylis flava,* because of the shorter stalk. Nevertheless it differs in the occasional septation and branching.

Of all the species, the only one other found to have branching trichomes was *B. Nevinii.* The trichomes there are septate (fig. 76), consisting of long cells similar to but slenderer than those of *B. lanata.* This species is outstanding in its variety of simple and branched trichomes. Sometimes where the stalk cell can be seen it is found definitely to give rise to several filaments. At other times this branching happens more distally. In this

respect it differs from those of other species of the subsection. As stated above, Robinson referred to these four otherwise closely related species as varying markedly in their pubescence. *B. microphylla* has been found to have the glandular biseriate type of trichome (see fig. 78) common to a great many species of the genus. The trichomes of *B. scabra* (see fig. 65) are really very thick-walled attenuate forms and in *B. Watsoni* Robinson are found the long acuminate forms figured for *B. lanata* (see fig. 75). Actually when examined, it is seen that these two have been considered as modifications of the uniseriate attenuate form. From these *B. Nevinii* differs most because it branches.

In addition to the above kinds, glandular trichomes have been found in this genus. In some species, such as *B. Wislizeni*, the pubescence of the leaves consisted almost entirely of trichomes of this type. Only a very few non-glandular trichomes were found on the midrib below, near the petiolar attachment and these were attenuate and similar to those seen in *B. betonicaefolia* and *B. amplexicaulis*. In *B. Wislizeni* and *B. Greenei* the glandular trichomes were the longest found in the genus (fig. 77). Each trichome consists of a stalk always two cells in diameter or exceptionally three in the very bottom row of some of the largest ones. Seen laterally, the actual gland at the top of the stalk consists of several successive pairs of flattened cells, eight to twelve in number. In outline this gland is somewhat globular, though shrunken by the treatment. Though examination of pedicels was not undertaken, the same kind was found on the phyllaries when sectioning flower material of *B. pendula* (fig. 82). Since this species was described as stipitate glandular and was figured with head-like glands on both the pedicels and phyllaries (fig. 64, Robinson) as were also other species including *B. Wislizeni* and *B. floribunda*, it is evident that this type of glandular trichome is found frequently throughout the genus. Its prevalence or absence, especially on pedicels and phyllaries, also led to the separation of varieties within species, e. g., *B. adenocarpa* var. *glandulipes*.

In the examination of other species, various sizes of these glandular trichomes were found. On *B. frutescens* Gray they varied upwards in size from mere papillate outgrowths to lengths less than those found in *B. Wislizeni*. By microscopic examina-

tion, the shortest ones were found to consist of pairs of small closely appressed hemispherical cells, not very different from the crescentic cells of the stomata. Looking down upon the flat surface of a leaf preparation they are recognized as being raised ever so slightly above the rest of the epidermal cells by a little difference of focal depth (fig. 79). As the shortest are ever so little above the surface they could be seen laterally better along a midrib as consisting of only a few pairs of undifferentiated cells (fig. 80). In one of four tiers of cells, however, the lowermost appeared to have already become slightly differentiated as basal stalk cells (fig. 81). The cells increase in numbers with repeated divisions and the whole trichome becomes longer as in *B. microphylla* (fig. 78). The stalks are always two cells wide, except only in the occasional basal tier of the largest trichomes and the gland was never found to consist of more than two rows of cells. The whole trichome is composed of biseriate cells in contrast to that of all of the non-glandular trichomes.

It was further found from the examination of cleared leaves of the many species that pairs of small hemispherical cells appeared quite regularly somewhat sunken in the epidermis. Although they were usually larger and their mid-walls were more uniformly appressed, they did suggest stomata. When both were seen

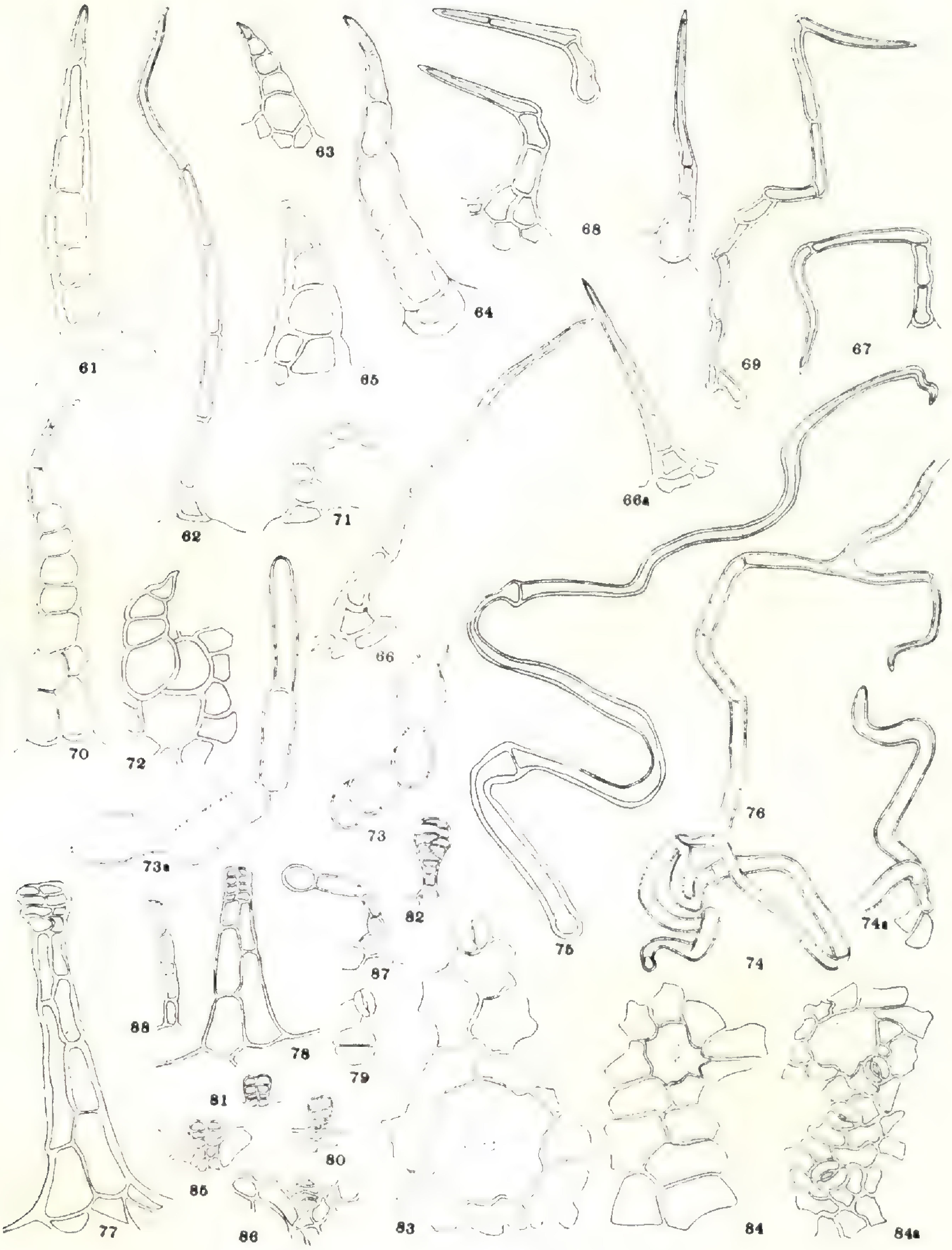
Plate 1196

EXPLANATION OF FIGURES

Figs. 61–76. Types of trichomes. 61. *B. betonicaefolia* (attenuate). 62. *B. paniculata* (long acuminate). 63. *B. diffusa* and 64. *B. monocephala* (short attenuate). 65. *B. scabra* (scabroid). 66. *B. Palmeri* var. *amphothrix*, long, and 66a, short, drawn *in situ*, and 67. *B. reticulata* (long acuminate towards cap differentiation). 68. *B. veronicaefolia* var. *veronicaefolia*, three drawn *in situ* and 69. *B. veronicaefolia* var. *senilis* (towards cap). 70. *B. californica* (moniliform). 71. *B. Rusbyi* (moniliform). 72. *B. laciniata* (short moniliform). 73. *B. dentata*, basal and 73a, apical. 74. *B. incana* (unseptate) and 74a, stalk cell with two branches. 75. *B. lanata* (very long acuminate). 76. *B. Nevinii* (branched).

Figs. 77–81. Glandular trichomes, biseriate, on leaves. 77. *B. Wislizeni* (large). 78. *B. microphylla*. Figs. 79–81. *B. frutescens*. 79. Origin in slightly raised pair of cells. 80. Lateral view of three tiers of undifferentiated cells. 81. Lateral view of four tiers of cells with basal stalk cells differentiated. 82. On phyllary: *B. pendula*. Figs. 83, 84. Punctate conditions. 83. *B. monocephala* (lower epidermis). 84. *B. cuspidata*, upper and 84a, lower epidermis, between the same two veins respectively. Figs. 85, 86. In margin of leaf, *B. glutinosa*. Figs. 87, 88. glandular trichomes, uniseriate, on leaves. 87. *B. argyrolepis*. 88. *B. Coulteri*. All drawings were made from cleared leaves except for Fig. 82, which was from a fixed, sectioned preparation, by use of camera lucida, × 510, reproduced at 1275 ×.

It is a pleasure to acknowledge the assistance of Mary Lou Slichter in the study and drawings of these trichomes, assistance given through the aid of a grant from the American Philosophical Society which was greatly appreciated.



FIGURES 61–88

together the difference was clear for that particular species. However, they can be very confusing because: (a) sometimes they are much smaller than the guard cells of the stomata (e. g., *B. cardiophylla* Robinson, upper epidermis); (b) they may be very sparsely scattered in some species (e. g., *B. Palmeri*) as are also the stomata on the upper surface; (c) they may be so abundant that it almost seems that they are the stomata (e. g., *B. glutinosa* Gray); (d) the size of the epidermal cells of leaves varies from species to species and the guard cells with them; (e) in some species the pattern on the upper and lower surface of the same leaf is so different in the size of cells as to cause confusion (e. g., *B. cuspidata*); (f) they may occur on both surfaces or more abundantly on the lower one. The only safe way was to find a stoma of that leaf surface for comparison.

These paired cells belong to the sessile glands to which reference was made by Robinson in *B. pulcherrima* and *B. Palmeri*. Robinson also called them atomiferous glands in *B. cuspidata, B. peninsularis* and *B. cordifolia* Ell. and minute glands in *B. diffusa*. They are conspicuous to the examiner of a leaf when a droplet of secretion can be seen. If the cells have not yet become secretory, it is very doubtful whether they would be seen. Since the size of the leaf chosen for this study was more suitable if it could be placed on a microscope slide, small and perhaps young leaves were often taken from the herbarium sheets. It was possible to find the glands by microscopic examination in almost all the species. None were seen either microscopically or macroscopically in the leaves of the limited specimens available of *B. glabrata* (Rose) Robinson, *B. brachiata* Gray or *B. megalodonta* Greene, and they occurred sparsely in *B. cymulifera* Robinson. On *B. hastata* Benth. and *B. megaphylla* they occurred less scantily. These are the species of very restricted distribution of the *Brachiatae*. All the specimens of the related *B. Coulteri* in the Gray Herbarium were examined with a hand lens and on only five of twenty-four of them could glandular secretions be seen.

It was found that the punctate condition referred to in a number of species of this genus, is associated with the position of these glands. When preparations of leaves of *B. scoparia, B. hymenochlaena* and *B. monocephala* were examined under the

microscope, the epidermal pattern was seen to be interrupted by what appear to be large "holes." Upon closer examination, in these can be found the same double cells, though usually on a lower level. No leaf sections were made to study the cellular details. However, they appeared to be somewhat funnel-shaped with a smaller inner diameter. Two oval bodies flattened against the adjoining mid-walls were usually distinguishable when, in the same preparation, no content was recognizable in the guard cells (*B. monocephala*, fig. 83). The two gland cells are bordered by a rather circular arrangement of smaller cells. Under the overlapping margins of the epidermal cells small foreign particles may collect. This emphasizes the slightly sunken nature of the gland. In other species described as minutely punctate or puncticulate (e. g., *B. dentata* and *B. macromera*) the gland cells, and consequently the "holes," are smaller. In *B. cuspidata* they are of intermediate size. This species serves well to illustrate the difference in size and distribution on the upper and lower epidermis of the same leaf (figs. 84 and 84a) which may account for Robinson's description of glandular atomiferous above and obscurely punctate below. It also may be possible that the secretions on the lower surface were not concurrently visible with those on the upper surface. It is believed that recognition of the punctate condition may be overlooked macroscopically and sometimes microscopically due to the age of the gland. Under the microscope this small organ is observed either when a droplet of secretion has formed, as an atomiferous or sessile gland, or subsequent to the disappearance of the secretion, as the punctate condition. Thus it depends on the maturity of the gland. An examination of plants grown in the greenhouse indicated this. On leaves of young seedling plants of fourteen species studied, although the gland cells were distinguishable with the microscope, no "holes" were seen in the leaves or leaf preparations. Preparations from herbarium specimens of the same species were recorded as punctate.

The leaves of most species of *Brickellia* are comparatively thin and have some trichomes along the margin. When the cleared preparation of the most fleshy-leaved of all species, *B. glutinosa*, was examined, the entire leaf margin appeared as a succession of minute depressions and rises. In the former, from

the sunken epidermal layer arose small familiar biseriate structures, the glandular trichomes (fig. 85, or seen laterally, fig. 86). Thus the two larger appressed cells seen so commonly on the leaf surfaces are explained by the two uppermost and largest cells of the series and we find the interpretation of the two smaller "bodies" in the smaller basal cells.

The earliest figures found to which these are comparable were those by Solereder (1899, figs. 103 G, H) of *Mikania pubescens* Nutt. and *Chrysanthemum cinerarifolium* Vis., after Vogl. The only bibliographical reference to this author included, does not pertain to those genera. The original figures have not been found. While the exact stage of development to which the figures apply is therefore not known, they might represent the depressed condition. In Solereder's text they are given as illustrations for short-stalked glandular hairs with a head consisting of two rows of cells, common to a number of genera of the *Compositae.* Among the latter are included those listed by Vuillemin (1884) as having biseriate glandular hairs. That adjective has been adopted for the depressed gland as well as the glandular trichome described for *Brickellia.*

It is certain from a comparison of figures given by other writers that while this type is common to very many genera they may vary in stages of development and final form. Steps shown by Rosenthaler and Stadler (1908) for a gland from the surface of a leaf of *Cnicus benedictus* are similar to those followed in *Brickellia,* yet the figure (24 IV Pl. III) of the mature stage has a greater diameter for its height than any seen in this genus. Those authors also include a more dissimilar figure (24 IV Pl. III) from the flowers, stating that it had a more hair-like form than on the leaf. Allowing for variation in height, a remarkable constancy was found in its form in *Brickellia.* The figure most closely resembling the longer biseriate trichome that has been found is of a stalked gland given by Hoffmann (1898, fig. 56B) in his introduction to the *Compositae* as occurring on the petiole of a *Eupatorium.* A general discussion of the terminology pertaining to the forms in all families can be found in Netolitzky (1932).

It is obvious since leaves of the same species can show glandular punctation either conspicuously or not at all, that macroscopic

observations of specimens would seem to vary. Robinson stated in his introduction that such punctation was normal in the leaves of the genus but was not always visible. It should also help to clarify matters if it is understood that in *Brickellia* biseriate glandular trichomes are outgrowths of the depressed glands which have been called sessile or atomiferous glands. These are the trichomes which are responsible for the so-called glandular pubescence. From the species cited, this probably holds for glandular puberulence as well, although some smaller glandular uniseriate, capitate trichomes may contribute an additional effect to a shorter indumentum. These were found very commonly especially along the veins of many species (fig. 87). They are small and have not been recognized macroscopically as they never attain the size of those on stalks of biseriate cells. The figure has been drawn from *B. argyrolepis* although it could have been drawn from a large number of species including those where the larger glandular trichomes prevail. There are slight variations from the globular shape to a more ovate terminal cell (*B. Coulteri*, fig. 88). The latter may be intermingled with the former. Similarly, they may vary in length of stalk to about six narrow cells. They distinctly come from one rather than twin cells and bear no relation to the depressed glands.

Observations from these leaf studies have been condensed in the form of table III. Since the species studied karyologically showed most of the distinctive types of trichomes, only those have been included. In the table no attempt was made to record the abundance in each category. Furthermore the condition recorded represents that of one or at most several specimens of any species.

It was found that where the biseriate glandular trichomes make up the pubescence either completely or with only a very few non-glandular trichomes, depressed glands are found rarely if at all (e. g., *B. floribunda* and *B. Wislizeni*). Conversely, species with extraordinarily punctate leaves or numerous depressed glands frequently seem to lack or have very small ones of this type very sparingly along the veins (e. g., *B. cuspidata* and *B. monocephala*). Occasionally such a trichome was found exceedingly rarely along the lower midrib as for instance in *B. scoparia* and *B. laciniata* where only one could be recorded after

examination of three different specimens. Such observations emphasize the interrelationship of the sessile glands and this type of glandular trichome in *Brickellia.*

Since depressed glands in the leaves are characteristic of this genus and glandular trichomes are merely an expression of their outgrowth, it is not surprising perhaps that no correlations between these organs and specific karyotypes have been found so far in this study. If more representatives of the *Brachiatae,* which seemed to lack, or show the glands more sparingly, were available, it would be very interesting to see if they would resemble the karyotype with satellites of *B. Coulteri.* The specimen studied cytologically was one of the nineteen on which no depressed glands were found without microscopic examination.

Several instances were found of correlation of the karyotype and the types of trichomes which are non-glandular.

1. This is especially noticeable in the *Baccharideae* where the karyotype consisted of shorter chromosomes. Although *B. laciniata* is almost glabrous and the trichomes are very few and very short, yet they were surprisingly moniliform like *B. californica* and *B. desertorum.* Those of *B. veronicaefolia* may be a little more distinctive in the tendency towards a cap cell, but it must be noticed that Robinson called these moniliform, likely due to their general contour.

2. Significant is the comparison of *B. Palmeri,* which in trichome as in chromosomal complement does not fit with the rest of the *Baccharideae.* The trichome is somewhat transitional and fits better with *B. glomerata.*

3. In the short trichomes of *B. Rusbyi,* there is similarity of type to those of *B. californica, B. desertorum* and *B. laciniata* as there is also in the karyotype.

4. *B. betonicaefolia* and *B. amplexicaulis* tie in with *B. Wislizeni* in having attenuate trichomes, despite the difference in size of heads.

5. *B. incana* is the most unusual, as it is in its karyotype of short chromosomes with one pair of satellites.

6. *B. lanata* has trichomes which, though longer, appear to be drawn-out long acuminate ones, and more similar to some species of the *Reticulatae* than to the long non-septate one of *B. incana,* next to which it had been placed.

TABLE III.—Types of Trichomes

	Species	Non-glandular Trichomes Uniseriate	Glandular Trichomes: Biseriate	Glandular Trichomes: Uniseriate, Capitate	Depressed Glands and Punctation in Epidermis: Upper	Depressed Glands and Punctation in Epidermis: Lower
Section I	*B. diffusa*	Short attenuate				×
Section VII Subsection 1. Clavigera	*B. scoparia*	Scabroid	Rare and short		×	×
3. Microphyllae	*B. microphylla*	Acuminate	Very short to longer ones			
	B. scabra	Scabroid	Very short ones		×	×
	B. Nevinii	Branched		×	×	×
4. Parvulae	*B. dentata*	"dentata"	Very short	×	×	×
	B. brachyphylla	Very short attenuate		×	×	×
5. Reticulatae	*B. venosa*	Long acuminate, towards cap		×	×	×
	B. oliganthes	Long acuminate, towards cap		×	×	×
	B. reticulata	Long acuminate, towards cap		×		×
	B. verbenacea	Long acuminate, towards cap		×		×
6. Amplexicaules	*B. cuspidata*	Short attenuate		×	×	×
	B. betonicaefolia	Attenuate		×		×
	B. amplexicaulis	Attenuate	×	×		
7. Brachiatae	*B. Coulteri*	Attenuate	×	×		×
	B. megaphylla	Long acuminate, towards cap		×		×
8. Baccharideae	*B. laciniata*	Moniliform	Rare and short	×		×
	B. desertorum	Moniliform		×	×	×
	B. californica	Moniliform		×		×
	B. veronicaefolia					
	var. *veronicaefolia*	Towards cap	×	×		×
	var. *umbratilis*	Towards cap	×	×		×
	var. *senilis*	Towards cap		×		×
	B. Palmeri					
	var. *amphothrix*	Long acuminate		×		×
9. Coleosanthus	*B. Rusbyi*	Moniliform		×		×
	B. glomerata	Attenuate toward cap		×	×	×
	B. paniculata	Long acuminate	×	×		×
	B. secundiflora					
	var. *secundiflora*	Attenuate to long acuminate		×		×
	B. tomentella	Attenuate to long acuminate		×		×
	B. nutanticeps	Attenuate		×		×
	B. pendula	Attenuate		×		×
	B. argyrolepis	Attenuate to long acuminate		×		×
	B. adenocarpa					
	var. *adenocarpa*	Long acuminate		×	×	×
	var. *glandulipes*	Long acuminate	×	×		
	B. pacayensis	(lacking)	×			
	B. floribunda	(lacking)	×			
Section VIII	*B. oblongifolia*	Attenuate	×		×	×
	B. Wislizeni	Attenuate	×	×		
	B. Greenei	(lacking)	×			
	B. macromera	Attenuate to moniliform	×		×	×
	B. peninsularis	Long acuminate		×	×	×
	B. grandiflora	Attenuate		×	×	×
	B. incana	Unseptate			×	×
	B. lanata	Very long acuminate				×
Section IX	*B. monocephala*	Attenuate		×	×	×

Types of trichomes as seen by microscopic examination of cleared leaves from annotated herbarium specimens at the Gray Herbarium. × indicates character present.

It should be emphasized that where one species of a pair (e. g., *B. cuspidata* and *B. lanata*) with similar karyotypes is either nearly glabrous or puberulent in contrast to pubescent, classification of the short trichome cannot be depended upon for correlation. Generally, there is more similarity in such abbreviated forms, *B. laciniata* being exceptional.

One instance of lack of variation of the karyotype accompanying varying kinds of trichomes was found in the subsection *Microphyllae.* However, examination of the types of trichomes of the four species suggests that they are really not so very different except for the branching in the one.

The epidermal cell pattern was found to be so variable in the leaves of the large number of species examined that many preparations would be necessary to make a worthwhile comparative study. The variability was impressive when seen in the leaves of young plants in the greenhouse. In fourteen species, the cell wall was consistently very undulate in outline. From leaves of these same species, taken from herbarium specimens, none were of the same extremely irregular outline. The shapes varied from slightly undulate to that of a block-like pattern. In some, the cells were more rectangular and in others almost isodiametric. Since, as was stated above, smaller leaves were chosen in order to permit mounting on a microscope slide, it is assumed that the differences in the epidermal pattern may have been due in part to the differences in ages of leaves selected. Without comparable specimens, growing under similar conditions, which would be most difficult in this genus, comparative data on the epidermal cells would be unsatisfactory.

Pappus

Differences in the number of setae of pappus failed to be of any value in classification, Robinson states, for they varied from one species to another from 10 to more than 80. Of their particular nature, less was written. The pappus was given significance in only one sectional heading, that of *Steviastrum* II, with three species, where it was stated to be short but distinctly plumose. Otherwise it is referred to only in *B. brachyphylla* as plumose, and in *B. monocephala* as somewhat plumose.

Lactic acid mounts, similar to those used in a study of *Liatris* hybrids (Gaiser, 1951) were examined, particularly of those

species studied karyologically, but with some additional ones to include other sections. Measurements of the length of the barbules showed considerable variation from those recognized by the taxonomist as plumose, which were the longest, to very short in the most delicate found (*B. diffusa*). Also they vary greatly in the number of barbules, being fewer and more distantly spaced on the seta in some and numerous and closely crowded on others. The variation on this basis is so great as to almost make the arrangement seem different when there are but few. At the tips of the setae, these barbules appear to come from the axis in a somewhat spiral fashion. However, for the main length of the seta, their arrangement is clearly distichous when the barbules are numerous so that they give the appearance of a mid rachis with short slanting pinnules. When there are fewer scattered barbules, the pattern is less regular. A striking exception to this, was noted in the annuals, *B. diffusa* and *B. filipes*, where there is also a median row of barbules, so that it becomes tri- instead of distichous.

As there are further inter-generic variations in the closely related group of the *Kuhniinae*, discussion for the whole group will be presented later (MS in preparation).

Discussion

It has generally been accepted that annuals have been derived from perennials and, among the latter, herbaceous ones from the woody types (Sinnott and Bailey, 1914). Eight perennial species of *Brickellia*, with equal representation of herbaceous and shrubby forms, differ markedly in their shorter chromosomes from twenty-five others with longer ones. Since the one annual of the genus in which the chromosomes have been studied has a karyotype of short chromosomes, it seems reasonable to assume that in this genus evolution has gone on generally in line with a reduction in chromatin mass. Delaunay (1926) was the first to postulate that reduction in chromosome size accompanied evolutionary advancement. In the genus *Crepis* of the *Cichoreae* (*Compositae*), the thorough studies of Babcock (1947) and a great number of his fellow workers, have shown a reduction in the number of chromosomes as well as of the size.

By this reduction hypothesis, the species with the greatest amount of chromatin would be considered the most primitive.

From the present study, this condition is found in *B. monocephala.* This species stands at the opposite extreme from *B. diffusa*, the two species appearing as the first and the ninety-first, or last, in Robinson's treatment of the genus. *B. monocephala* is a singular species with only a solitary terminal head, borne on a long, naked peduncle. It consists of well over one hundred florets, in contrast to the slender heads of about eight flowers in a large loose panicle, of *B. diffusa.* The phyllaries are broadest and the only ones in the genus to have markedly scarious margins. The achenes of the former are the third largest of the genus. Underground it has a short fleshy rhizome with one or two annual buds, as seen in a fresh specimen received from Mexico, in contrast to the fibrous root system of the annual and of many of the other perennial species. It is known from very limited localities, as the hills of El Salto in Mexico state where it borders on Hidalgo, the environs of Morélia, and one collection from Durango. The species, *B. hymenochlaena* Gray, with a similar knobby root, has about a dozen heads, approximately 40-flowered, borne somewhat as an umbel on one stem. It also is rare[10] and found only in the mountains of San Luis Potosi, Hidalgo, Puebla and Oaxaca. Another species, *B. simplex* Gray, which is rather intermediate between these two, since it occurs either with single large heads or a few of about sixty flowers on one long peduncle, seems to be a related species of the northern Mexican States, Chihuahua, Sonora, and adjoining Arizona. Though these two species were not represented in this cytological study, we believe that the next most nearly related species is *B. grandiflora*, which has a long fusiform root and heads of 20–38 flowers. In the general section on root, rootstock and caudex of his introduction, Robinson singled out these species as having a form exceptional to the prevailingly slender fibrous one. The four are very similar in having petiolate, deltoid to ovate leaves, as well. *B. grandiflora* was found to have a karyotype approximating the size of that of *B. monocephala.* The former is one of the species with the widest range in the United States where it reaches the northern limits of the genus. Thus, it has more successfully adapted itself than the other three. With the largest chromosomes found in *B. monocephala*, and probably the

[10] In conversation with the late Prof. Conzatti, he stated this species was very difficult to find.

next in *B. grandiflora*, it is possible that these represent a line of specialization in root-form from a primitive group and of them the nearest to the ancestral type may well be *B. monocephala.*

While these are herbaceous perennials, among the shrubby species, at least *B. argyrolepis*, *B. pacayensis* and *B. adenocarpa*, having heads of 25–30 flowers, had chromosomes almost if not equally as long as *B. grandiflora*, apparently also lacking two of the short class. It is not possible to say whether the present day herbaceous or shrubby types have evolved more rapidly. It is evident, nevertheless, that among the shrubby ones, and possibly in the woodiest of the genus, *B. argyrolepis*, appears a karyotype of chromosomes closely approaching what should be the most ancestral according to the hypothesis of reduction. That group, however, suggests by the form of root, as well as the more perishable above-ground parts, a specialization which may have started off from a shrubby ancestor unlike any we have today. As phylogenetic changes rarely have been found to move in one straight line, it is readily understandable, too, that in the woody forms the heads might be more reduced. There is at least good correlation between taxonomic characters and chromosome size moving in unison in evolutionary changes in *Brickellia.* At the one extreme occurs an annual with short chromosomes and at the other a perennial with the longest chromosomes, and next to it related perennials and woody shrubs with chromosomes of approaching length. That in between a minority of shrubs, and perennials also, have short chromosomes, may perhaps show the way.

As yet no direct evidence has been obtained which would explain the amount of shortening of chromosomes from the general size as in those of a species like *B. californica.* Some indications of how slight reduction of chromatin content might occur, were seen among the preparations studied. Twelve accessions of this species showed an unvarying karyotype of short chromosomes. However, in one other, from the Chiricahua Mountains of Arizona, a terminal body was frequently seen on one of the longest chromosomes. Although this was not a regular feature of the species, it may be of that population. If that segment of the chromosome were heterochromatic and lacking in genes of particular significance, it might become separated and lost

without too great disturbance. That would accomplish a shortening of that chromosome. There was similar evidence at the apex of a chromosome in one plate of the only accession of *B. Wislizeni* from northern Durango. Just what would cause a break or rearrangement in the chromosomes is unknown.

It is noteworthy perhaps that the particular collection of *B. californica,* in which the segment occurred, had been growing at an elevation of 7000 feet. For nine of the thirteen accessions the altitude was given and only the one from the same locality but at about 9000 feet (e. g., XVII), was reported from an altitude that was greater. Whether the altitude and any other factors connected with it are of any significance is a question. Furthermore, it may be more than coincidental that that collection came from New Mexico. This is just the region for the two less widely distributed perennials with the short chromosomes, *B. Rusbyi* and *B. floribunda.* It may be of interest that the observation was made in a species in which the chromosomes were already short and in one in which there was one pair of this type (e. g., *B. Wislizeni*). Also, it was found in a shrub and a perennial alike.

In a group of Mexican species of subsection *Coleosanthus,* irregularities of meiosis, indicating that inversions had taken place, might lead to rearrangements and some deficiencies. Significant as their effects might be, it is hard to understand how they would change the length of the chromosomes so drastically.

Besides, the parallelism between the trend to reduction in chromosome size and in reduction of length of life cycle, as seen in the annual and perhaps these two perennials, suggests that it is one of major phylogenetic significance.

In a number of species, genotypic control of meiotic chromosome length has been reported, as first found by Lesley and Frost (1927) in *Matthiola incana.* In these instances the alterations in length from the normal were found in races of a species and it is not known if these are of more than intraspecific significance.

(*To be continued*)

Prairie Variety of Solidago gigantea.—S. gigantea Ait., var. **Pitcheri** (Nutt.) Shinners, comb nov. *S. Pitcheri* Nutt., Journ. Phila. Acad. **7:** 101–102. 1834. Type: "In Arkansas," *Dr. Pitcher* (in Herb. Philadelphia Academy; measurements kindly supplied by the late Dr. F. W. Pennell in 1943, specimen personally examined in 1946).

Stem leaves 2–4 cm. wide, middle ones mostly less than 5 times as long as wide, coarsely serrate; lower panicle branches 5–25 cm. long, commonly more than 10 cm. In var. *gigantea* and the hardly separable var. *leiophylla* Fernald, the stem leaves are 1–2.5 cm. wide, middle ones mostly more than 5 times as long as wide, more finely serrate; lower panicle branches 3–15 cm. long, commonly less than 10 cm.

Var. *Pitcheri* occurs primarily in the low prairies of Iowa, Illinois, southern Wisconsin and Minnesota, extending eastward locally as far as Cincinnati, Ohio, and northwestward to south-central Alberta; intergrading freely with narrow-leaved races where the ranges overlap. The leaves vary from glabrous (so described by Nuttall) to pubescent over the surface beneath. In at least some cases, the pubescence of both var. *Pitcheri* and var. *gigantea* is certainly derived from introgression with other species, particularly *S. altissima* L., with which they grow and with which apparent hybrids have been observed in the field. *Solidago dumetorum* Lunell (Amer. Midl. Nat. **2:** 57, 1911) and *S. satanica* Lunell, l. c. (types in Herb. University of Minnesota, both from North Dakota) have the appearance of hybrids between *S. gigantea* var. *Pitcheri* and *S. pruinosa* Greene. They are at any rate extremely similar, and are not referable to two different species. Some Colorado and Wyoming plants have the appearance of Midwestern var. *Pitcheri*, but slightly longer (though not narrower) leaves, the length more than 5 times the width. I consider these local forms of var. *Pitcheri*. They possibly are the result of crossing with *S. lepida* DC. var. *elongata* (Nutt.) Fernald or other Western species. *S. gigantea* is also represented in the Rocky Mountains and Northwest by var. *salebrosa* (Piper) Friesner (Butler Univ. Bot. Studies **5:** 113, 1941) differing from the other varieties in having a pubescent instead of glabrous stem.—Lloyd H. Shinners, Southern Methodist University, Dallas, Texas.

DRABA LEMMONI.—There is a population of *Draba* in the Sweetwater Mountains area of Mono County, California, that appears to stand in about the same relationship to *D. Lemmoni*, var. *Lemmoni*, as does the eastern Oregon *D. Lemmoni*, var. *cyclomorpha.* The following key shows the principal differentiating characteristics of the two California varieties:

Scapes, pedicels and siliques hirsute with simple or forked trichomes; siliques contorted; leaves hirsute on blade surfaces and margins with simple and forked trichomes . . . . *D. Lemmoni*, var. *Lemmoni.*
Scapes, pedicels and siliques glabrous; siliques plain; leaves sparingly hirsute along margins with simple trichomes . . *D. Lemmoni*, var. *incrassata.*

DRABA LEMMONI S. Wats., var. **incrassata** Rollins, var. nov. Herba perennis caespitosa; foliis rosulatis crassis obovatis ciliatis; pedicellis glabris; siliquis ellipticis glabris 4–7 mm. longis, 3–4 mm. latis; stylis 0.5–1 mm. longis.

Caespitose perennial with a deep root system; caudex repeatedly branched, covered with old leaf-bases; leaves obovate, rounded above, thick, glabrous or sparingly ciliate with simple trichomes along margin; 4–10 mm. long, 1.5–3 mm. wide; scapes glabrous; flowers yellow; pedicels spreading, slightly curved upward, glabrous, 4–6 mm. long; siliques glabrous or with a few small trichomes, elliptical to nearly orbicular, 4–7 mm. long, 3–4 mm. broad; style 0.5–1 mm. long.

Type in the herbarium of the University of California, Berkeley, collected on rockslide below snowbank, ridge southwest of Sweetwater Canyon, Sweetwater Mountains, Mono County, California. Alt. 9,200 ft., July 17, 1944, *Annie M. Alexander and Louise Kellogg 3905.* Isotypes at Dudley Herbarium, Stanford, and the Gray Herbarium. Other collections studied, all from the Sweetwater Mountains of Mono County: Desert Creek Divide, Alt. 11,400 ft., Aug. 8, 1945, *Alexander & Kellogg 4559* (DS, UC); Mt. Patterson, July 29, 1941, *Robert F. Hoover 5551* (GH); Deep Creek, Alt. 10,200 ft., Aug. 1–7, 1944, *Alexander & Kellogg 3984* (DS, UC); east wall of Desert Creek Canyon, Alt. 11,000 ft., Aug. 7, 1945, *Alexander & Kellogg 4549* (DS, UC).

The leaves of var. *incrassata* are smaller, thicker and with a fainter nerve on the lower side than those of var. *Lemmoni.* A vein pattern can be seen on the valve surfaces of most of the siliques of var. *incrassata*, but I have not been able to make out such a pattern on the siliques of var. *Lemmoni.*

There is considerable variation in silique size, shape and the length of the style in var. *incrassata.* Other characteristics appear to vary less, but petal size and shape is also somewhat variable. It is not possible, at present, to get at the causes of

this variation, although it is fairly safe to assume it is not wholly environmental in origin. *D. Lemmoni* occurs at very high altitudes and the populations are often separated by considerable distance. The semi-isolation resulting from this physical separation is probably a major factor in producing the local variants found in the species, but the plants of the Sweetwater Mountains alone show a range of variation that is nearly equal to that of the rest of the species put together. *D. Lemmoni* as a whole deserves further study when additional material can be obtained.—Reed C. Rollins.

Aster shortii ssp. azureus (Lindl.), stat. nov.—Based upon *Aster azureus* Lindl., Hook., Comp. Bot. Mag. *1*: 98. 1835. The midwestern species *A. shortii* Lindl. and *A. azureus* Lindl. were artificially hybridized during the course of an investigation of the heterophyllous asters.[1] The results of these crossings showed that these two species behaved differently from the rest of the group with regard to ease of crossability and gene exchange. The information suggested that the two taxa had not sufficiently diverged genetically to be maintained as distinct taxonomic species.

The relegation of *A. azureus* to subspecific rather than varietal rank was based upon its geographical distribution in relation to that of *A. shortii*. These subspecies are allopatric in most of their range but do occur together in a triangular area from northern Ohio to southeastern Minnesota, eastern Iowa, and southern Illinois. *Aster shortii* ssp. *shortii* is found mostly east of the Mississippi River from southern Wisconsin to Georgia and Alabama while *A. shortii* ssp. *azureus* occurs in the states bordering the Great Lakes and south to Louisiana and eastern Texas.

Hence, despite morphological and ecological differentiation of *A. shortii* and *A. azureus*, the lack of genetic barriers to hybridization is, in the writer's judgment, sufficient basis for nomenclatorial revision.—Charlotte J. Avers, Indiana University, Bloomington, Indiana.

[1] Avers, Charlotte J., Biosystematic studies in *Aster*. I. Crossing relationships in the Heterophylli. In ms. (1953).

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PLATE 1197. Two plants of *T. dubius* showing relative sizes and characters. (A) Larger and more typical plant. (B) Smaller and less frequent plant.

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A NOMENCLATURAL NOTE IN THE GENUS TRAGOPOGON*

F. H. MONTGOMERY

WHILE examining specimens of the genus *Tragopogon* (Goatsbeard) occurring in Ontario, it was found that in the species with lemon-yellow ligules (*T. major* Jacq. in the recent edition of Gray's Manual, and *T. dubius* in the new Britton and Brown "Illustrated Flora" 1952) there was great variation in the size of the plants, the amount of branching, the size of the heads, and the number of involucral bracts. The plants varied from 15 to 76 cm. in height; some were single-stemmed, while others were almost bushy in character; the mature heads ranged from 2.5 to 7.5 cm. in diameter, and the number of involucral bracts varied from 8 to 13.

The question arose whether these were all *T. major* as described by Jacquin, whether some were *T. major* and others the *T. dubius* of Scopoli, whether the variations should be considered as sub-species of *T. dubius* as recognized by some European authors or whether they all should be classified simply as *T. dubius*. Shinners has argued for the use of *T. major* as the name for our species, but his inferences concerning the specific distinctness of the original *T. dubius* do not seem to be clearly established.

Recourse to Hegi's "Illustrierte Flora von Mittel–Europa" did not help to solve these difficulties. Hegi's description of *T. dubius* ssp. *major* and his fig. 732 do not agree, and the identity of the figure is doubtful. It is not similar to Jacquin's illustration of *T. major*, nor to the plants growing in this province which we believe to be similar to Jacquin's species. Furthermore, Hegi's

* This investigation was supported by the assistance of a grant from the Research Council of Ontario.

fig. 733a of *T. dubius* ssp. *dubius* illustrates the larger plants which are growing in Ontario (fig. 1a) and his fig. 733b is characteristic of the smaller plants (fig. 1b).

To clarify the nomenclature of the species and to determine the relationship, if any, between *T. dubius* Scop. and *T. major* Jacq., a review was made of the literature pertaining to the origin and use of the nomenclature by former authors. Also, information was assembled concerning the life history and ecology of the species to determine the effect of these on the nature of the plants. Considerable effort was made to obtain photographs of Scopoli's types, but after much correspondence with European herbaria, we were informed by Prof. R. Ciferri of the University of Pavia that most of Scopoli's types have been lost. It is realized, then, that the basic problem of the identity of Scopoli's *T. dubius* remains unsolved, and must remain so under these circumstances. The understanding of the species, therefore, must be based upon the interpretation of literature relating to this species.

Scopoli (1772) described *T. dubius* from material collected in the region of Trieste. From his brief description and an accompanying comparison with *T. pratensis*, the plant may be described as small, unbranched, somewhat flocculose, leaves flat, having no undulations on the margins and no curling of the tips of the blades; heads about 2.5 cm. in diameter; the ligules sulphur-colored and shorter than the involucral bracts.

In 1773, Jacquin, with greater detail, described and illustrated *T. major*. It did not differ essentially from *T. dubius* except for its greater size, its branching habit and larger heads.

For nearly 100 years European authors of floras used Jacquin's name *T. major* and placed *T. dubius* in synonymy. In 1859 Grenier stated that the specific name should be *T. dubius* because of the earlier publication of this name. Index Kewensis, 1895, reduced *T. major* to synonymy under *T. dubius* and in his "Flore de France," 1903, Coste used this nomenclature. About this time, botanists also began to take note of the two forms of the species and in 1908 Rouy, although retaining *T. major*, made a sub-species *dubius* to accommodate the smaller plants. *T. dubius* was taken up by Vollman, 1910, but in his "Flora von Bayern," 1914, he said only the ssp. *major* was

found in that area. This combination was followed by later German authors. Schinz and Thellung disagreed with Rouy that the smaller plants were a ssp. of *T. major*, and made the combination *T. dubius* ssp. *dubius*, and this nomenclature was included in the works of Schinz and Keller, and Hegi. From this literature review it would seem that *T. dubius* ssp. *major* was intended to cover large specimens of this species, and these seemed to be the more common in the areas covered by the floras: *T. dubius* ssp. *dubius* was used to indicate the smaller plants.

The species shows great plasticity, and this is particularly evident under varying environmental conditions. Where growing conditions are optimum, large vigorous plants are the most frequent; but where soil conditions are poor, or where normal growth is interrupted, e. g. by mowing of the roadsides, only depauperate plants occur. Where soil conditions are variable, as along road or railroad embankments, near gravel pits, or where only a part of a roadside is mowed, plants of both forms are to be found. Sometimes they may grade from extremely small plants to large plants.

Ownbey (personal correspondence) has found that the time of germination of the seeds is also a factor affecting plant characteristics. Seeds germinating in the spring may flower the same year, and the plants are annual and of the reduced type. If they germinate late in the season and survive the winter, they flower the following spring, but have not yet reached their greatest maturity and are therefore small in character. Ownbey has grown seeds of both large and small plants under similar conditions in experimental plots in the State of Washington, and the resulting offspring have been indistinguishable. In the absence of genetic factors that would cause the extreme variations that have been mentioned here, he is not inclined to assign taxonomic value to these differences.

From the literature reviewed, field studies, and genetical studies it appears that *T. dubius* Scop. and *T. major* Jacq. are identical, and that a separation into sub-species by Schinz and Keller, Hegi and others is unnecessary. Since *T. dubius* Scop. has priority, our lemon-yellow *Tragopogon* species should receive this name.

I wish to thank Dr. Reed C. Rollins, Director of the Gray Herbarium, and Dr. I. M. Johnston of the Arnold Arboretum for permission to use the library facilities of these institutions; Miss Marjorie Stone, Librarian of the Gray Herbarium for her generous assistance while working in the library; Dr. Marion Ownbey for reading the manuscript, and numerous helpful suggestions.—Department of Botany, Ontario Agricultural College, Guelph, Ontario.

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CHROMOSOME STUDIES IN KUHNIINAE (EUPATORIEAE). I. BRICKELLIA

L. O. Gaiser

(*Continued from p. 321*)

It is considered that there has been consistency in the effects of temperature on meiotic coiling (Swanson, 1942). He found that both high and low temperature caused a greater than normal contraction of chromosome length. We cannot explain what caused one cell of *B. glomerata* in a Feulgen preparation to contract as much as many resulting from pretreatment with paradichlorobenzene in *B. microphylla*. Both gave evidence of the possibility of contraction of the chromosome length normal to these species, by chemical means. Thus it may be that by genic action the same has been accomplished under natural

conditions in *Brickellia*. Like the influence of a gene or genes, it has been effective along several different lines and probably at different times, as in the xerophytic shrubs of the *Baccharideae*, the two perennials, *B. Rusbyi* and *B. floribunda*, and the restricted forms, *B. Greenei* and *B. incana*.

In *Crepis*, which is almost world wide in distribution, there are at least 40 annuals and 143 perennials with 13 variables. In that genus there is ample evidence of progressive reduction of plants going along with the change from perennials to annuals. And there is the same parallelism with reduced chromosome size. A glance at the chromosome figures of the frontispiece (Babcock, 1947) shows one karyotype and what could be a reduced replica of it, for a primitive and advanced species respectively. That author stated there was as yet no direct evidence of the cause of the reduction but that it might well depend upon gene mutations.

At present, less has been accumulated for *Brickellia* on a progressive adaptation to a more and more xerophytic environment and yet it is just in the species of that habitat that morphological changes of chromosomes have occurred.

If we consider the species having karyotypes representing an amount of chromatin which is less than that found in the majority of species, the group is found to include the one species, so well characterized by its name, *B. incana*, which is notably xerophytic and is of restricted distribution in southern California and Nevada, and *B. Greenei* also confined to a region of northern California and Oregon. No reference has been made to this species being xerophytic. The locality of the type specimen was along the south fork of the Scott River, Siskyou Co. and the specimen here studied was collected on the South Fork Indian Creek, in the Siskyou Mountains. Of the habitat, the collector, Dr. L. C. Wheeler, has written: "It was found on a hot dry flat, a few feet above and probably between one and two hundred feet from the living stream, on the north side of an easterly-westerly canyon. In sites of this sort at low elevations in the Siskyous (this was probably ca. 1500 ft. elevation) it becomes very hot and dry in summer. This habitat is far enough above and away from the main streams that it is disturbed by streamflow only in rare floods." This certainly grew in a xeric situation. There are also *B. desertorum*, the extremely xerophytic member of the sub-

section *Baccharideae*, of approximately the same range as *B. incana*, and the more widely distributed *B. californica* to which it is considered similar. With *B. laciniata* and *B. veronicaefolia* there are included four of the seven (the eighth considered elsewhere) of that subsection, described as more or less xerophytic. The only other subsection similarly characterized, which is represented in this study, is the *Microphyllae*, consisting of four species. While the three here included do not have karyotypes of the shortest chromosomes, they come next to this extreme. Then there are *B. Rusbyi* and *B. floribunda*, described as herbaceous somewhat shrubby perennials occurring in the Arizona and New Mexico Mountains. Among all these, there seems to be a considerable stress on their xerophytic nature, If we take the reduction in chromosome size seen in their karyotypes as evidence of their evolutionary position in the genus *Brickellia*, it might exemplify the hypothesis of Stebbins (1951) that "Environments limiting or deficient in one all important factor, moisture, have often promoted evolution." While no species of *Brickellia* is palustrine, among the more mesophytic ones examined, none have the complement of shorter chromosomes. That the one species having the longest chromosomes of all is found on low mountains of the plateaus may seem to contradict the hypothesis. However, with successful storage capacity in a fleshy rhizome, it may well represent a successful adaptation of a primitive form. It has been noticed in this connection that *B. monocephala* is among the very earliest to flower and mature. Before the rainy season had ended, in mid-August, this species was in bloom on the hills of El Salto and had some ripened seeds. When the collector* returned for more seeds, near the end of September, no plants could be found, partly because of the rich growth of later composites such as *Cosmos*. As a reason for rapid evolution in arid regions, Stebbins listed storage roots among the many specialized structures which plants have as adaptations for drier climates.

As Babcock (*l. c.*) has so ably pointed out, the goal is to coordinate the evidence from cytology with comparative morphology. Thus reëxamination of some morphological details may reveal discrepancies in taxonomic treatments.

* By private communication from Mr. D. B. Gold, Mexico City.

With regard to the achene, Robinson's attention was especially centered on the number of ribs, since with one marked exception (*B. Fendleri* Gray), this was constant for the genus. There was no discussion of the variation in size though it was included in the descriptions, with accompanying drawings, of all but twenty-two species. By supplementing the sizes of any others of which material has been available for these studies, five blanks could be filled (e. g., *B. brachyphylla*, 5 mm., *B. venosa*, 3 mm., *B. oliganthes*, 3.5 mm., *B. glomerata*, 3.7 mm., and *B. Rusbyi*, 3 mm.). Using only these figures, in addition to those of Robinson, several general observations come clearly into focus. The largest achene is that of *B. incana*, 10 mm., the second is *B. Greenei*, 7 mm., and the third is *B. monocephala*, 6 mm. Three species have achenes of 5.5 mm.: *B. argyrolepis*, *B. pendula* and *B. squarrosa* (Cav.) Robinson. Among the next with achenes of 5 mm. are *B. adenocarpa* and *B. grandiflora*. The shortest is *B. diffusa*, 1.7–2 mm. Two unstudied, narrow-leaved species come next. These are closely followed by *B. floribunda*, 2 mm. There are ten species of the size between 2 and 3 mm. of which *B. filipes*, the second annual, is shortest, 2.2 mm., and this is followed next by one unstudied species of the *Baccharideae*, *B. baccharidea* Gray, 2–2.3 mm., and *B. desertorum*, 2.3 mm. While five other species, scattered here and there through the genus follow, *B. laciniata*, 2.8 mm., *B. californica*, 3 mm., also of the *Baccharideae*, and *B. Rusbyi*, 3 mm., come next. The other forty-two species have values between 3 and 6 mm.

It is impossible to say that reduction of achene size is parallel to chromosome size in all of that group, for there are exceptions. But those studied which have the longest chromosomes are among those having the largest seeds with the exceptions of *B. incana* and *B. Greenei*. Those which have short chromosomes are with the same two exceptions, among those having very small fruits. Also, it is clear that *B. Rusbyi* and *B. floribunda* come close to the *Baccharideae* in yet another character.

There is agreement here with the findings in *Crepis* as is so strongly emphasized in the colored frontispiece (Babcock, *l. c.*) which shows two species, one a perennial and the other an annual, both having the same chromosome number 5. The former is the most primitive species with that complement and has a large

fruit. The latter and most advanced has a very much smaller one. A second pair of species (figs. A and B) are used similarly to illustrate many size differences which have become reduced in the line of advance. Of the annual, considered to be the most advanced in the genus, mention is made of "the remarkable longevity of the tiny achenes." This had been the unanticipated but much appreciated surprise in finding *B. diffusa* viable after five years, when the shrub from Costa Rica was much less so after five months and others from western United States at least after two years.

From the species studied, there has been a reduction in size of flower heads and the achene where a marked diminution of the chromosomes has been found, with the two exceptions *B. Greenei* and *B. incana*. To a considerable extent and with the same species excepted, the number of florets in the head have shown the same trend although with considerable overlapping. There is also evidence of reduction of the plant and its parts, especially in the extremes, when we compare the annual with a large woody shrub having a stem two inches in diameter, or its small fibrous root with the large strong roots of the same shrub or even the fleshy rhizomatous ones of others. Without a complete study of all species, comparative generalizations are out of order. However, there is at least strong similarity to these parallel phylogenetic changes stated for *Crepis* by Babcock (*l. c.*). Even for the exceptional *B. Greenei* and *B. incana* a parallel can be found in *Crepis* in the statement that a decrease in chromosome size was found to be associated with a specialized and restricted distribution of the species. The greatest points of difference are the progressive decrease in number and increase in asymmetry of chromosomes, with the least well marked trend in the diminution of the chromosomes in *Crepis*. Almost the converse holds in *Brickellia* with no change in their number and marked reduction in size. Lack of much evidence of an increase in asymmetry of their form may of course be due to the examination of an insufficient number of species. Satellites were found in three species. Recognizing that they are very small in *B. Greenei* and *B. incana*, they could have been missed and may possibly have been in some others. Yet the very successful and widespread annual, *B. diffusa*, which has attained the peak in this genus, has shown

no recognizable tendency in this direction. It may be, that lack of quite as many phylogenetic changes in the chromosomes of this smaller genus finds some explanation in its still comparatively limited distribution, occurring only in the new world and mainly the northern hemisphere, in contrast to the world wide distribution of *Crepis.*

Because the number of florets per head was considered to be fairly constant, Robinson used it successfully in conjunction with other characters, for the primary divisions of the genus. Thus he had separated section *Macrobrickellia* from *Eubrickellia* and the latter from *Bulbostylis* on the basis of larger heads. Separation of the latter, 28- to 62- rather than 20- to 26-flowered, he stated, both in the introduction as well as under the sectional heading, was one of less significance but of greater convenience for classification. To avoid errors in identification, one species, *B. grandiflora,* with 20 to 38 flowers per head, appears in the keys of both. Of significance in this relation is the fact that within one clearly defined species, *B. veronicaefolia* of section *Bulbostylis,* the number of florets may vary from 18 in variety *veronicaefolia* to 62 in *umbratilis.* With such an overlap in the number of florets per head in several individual species, it may be permissible to disregard boundaries between what appear to be specific affinities at other inter- and intra-sectional levels.

In several pairs of species, of which one was placed in each of the sections *Bulbostylis* and *Eubrickellia,* it was brought forcibly to my attention, perhaps more so as a result of examining trichomes and the cleared leaves on which they were observed, that one of the two approaches a somewhat smaller, or reduced example of the other. This was first recognized from seeing the strongly reticulate and unusual arcuate venation common to the coriaceous leaves of *B. cuspidata* and *B. lanata.* It was found that this greater prominence of the submarginal veins was due to sclerenchymatous walls surrounding the veins or veinlets. The almost glabrous leaf of the former with a short petiole is distinctive in having a cusp at its tip while the larger, longer-petiolate leaf of the latter is generally serrate with few sharply pointed teeth and is covered with long slender trichomes in the juvenile condition, becoming more or less glabrous later. However, as recognized in variety *microdonta* Robinson, the serrations may be

very shallow and mucronate and the leaf almost sessile. While not collecting a match for this variety, there were at one location near Guadalajara, a number of plants with characteristically broadly ovate leaves and of one plant they were petiolate yet practically without serrations. In the barranca, where *B. lanata II* was collected, the form of leaf was rather broadly lanceolate, much narrower than in any of the three other collections. Also, although only a few seeds of typical *B. cuspidata* were received from the collector in Guadalajara, small leaf samples of three plants had been sent earlier for purposes of identification, and of these, one shows a marked variation to a more dentate leaf with a less prominent terminal cusp. Thus the difference between the almost entire ovate leaf of *B. cuspidata*, as shown in figure 33 of Robinson, in subsection *Amplexicaules*, and the coarsely serrate one of typical *B. lanata* of figure 94 in *Eubrickellia* is lessened. As known at present, *B. cuspidata* is apparently more rare, and restricted to the vicinity of Guadalajara, while *B. lanata* is of wider distribution in Jalisco. However, there was a possible reason for our missing it in the collector's recent note that it is "so much smaller."

A second example can be quoted in the striking similarity of *B. amplexicaulis* of subsection *Amplexicaules* and *B. Wislizeni* of *Eubrickellia* with heads 13- to 22-flowered in the former and 50- to 60- in the latter. Modifications resulting under similar greenhouse conditions, gave smaller heads and left a much narrower gap between these two. Both have membranaceous leaves. Although those of *B. Wislizeni* were described as pubescent on both sides, the indumentum in this species is of glandular trichomes which are the longest found in the genus. Those of *B. amplexicaulis*, described as having hairs of inequal length above, and copiously pubescent below, more so on the basal veins, were found to have the same kind of glandular trichomes of a variety of lengths on the upper surface. The trichomes on the lower were of the attenuate type, like those of *B. betonicaefolia*, a nearly related species. A few hairs found only on the midrib below and near the petiolar attachment of a leaf of *B. Wislizeni* were found to be of the same kind. Gray (1853, p. 72) when describing *B. betonicaefolia*, four years after he had named *B. Wislizeni*, stated it was more closely related to the latter than

to any of the section which contains *B. Cavanillesii,* which is now *B. adenocarpa.*

With a complete representation of the genus, other such alliances might be found. Interest has already centered on several pairs or small groups of species which would make interesting test cases of this cyto-taxonomic approach.

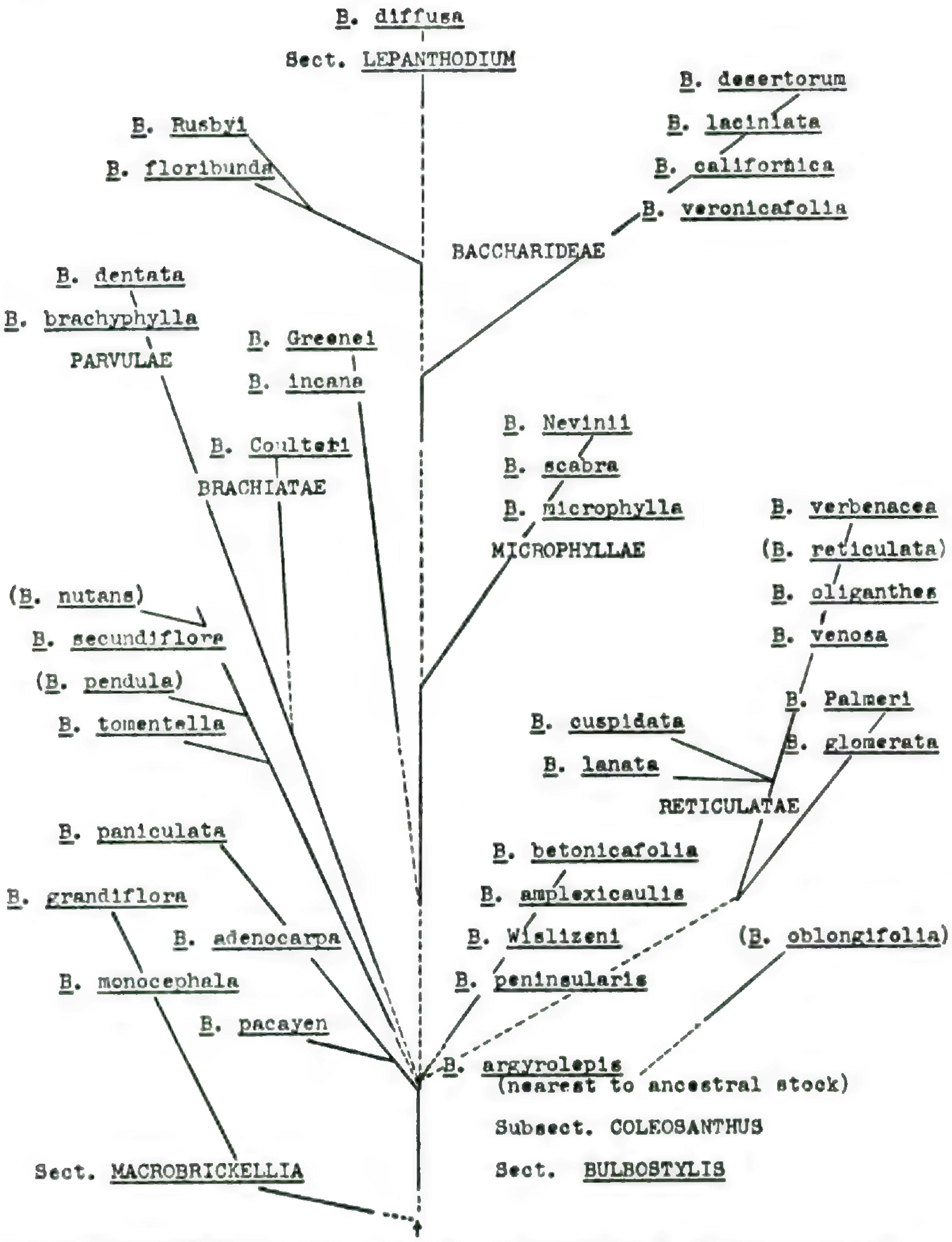
From a combination of taxonomic characters, along with the summarized items on karyotypic variations, an arrangement according to their probable evolutionary relationships has been attempted of those species studied (p. 336). To this end, the figures of the karyotypes were arranged in a somewhat similar order from 1 to 30, although the species have a reticulate rather than linear relationship. Four recently received species are included in figures 33, 34, 36, and 41.

From the discussion of what has seemed a somewhat artificial separation of some species from the subsection *Coleosanthus* to section *Eubrickellia* we would omit the latter, at least for those treated here.

SECTION MACROBRICKELLIA.

Because *B. monocephala,* with the largest heads, though primitive from several points of view, appears to show particular specialization, it is considered as a kind of sidebranch from an earlier ancestral stock. Along with it would be grouped what have been discussed as probably closely related species, though they are as yet unstudied cytologically: *B. hymenochlaena* and *B. simplex,* and in line with those, *B. grandiflora.* The three latter had been placed in *Eubrickellia* having the next largest heads. Their inclusion here would broaden this section, making it significant in relationships of root and leaf as well as similarity of heads and karyotypes.

It would hardly be justifiable to separate off the next from the above mentioned species of subsection *Coleosanthus,* although in their karyotypes a second pair of short chromosomes was more generally recognized. These include in a continuing link, the group of perennials such as *B. paniculata, B. secundiflora,* and *B. tomentella,* in which the type of trichome varies little in length of septation, *B. pendula* with glandular trichomes in addition, as has one variety of *secundiflora,* and the merely puberulent *B. nutanticeps.* All are from Mexico.



PHYLOGENITIC CHART OF SOME SPECIES OF BRICKELLIA

Figure 89

Those above have all had leaves of a somewhat broadened category. The limited material of the distinctively narrower leaved species with entire margins, *B. oblongifolia* var. *linifolia*, with a crowded plate of long chromosomes, would place it approximately in this position. However, no other species has

been studied that seems closely associated. With other narrow-leaved species unrepresented, such as the pair *B. pulcherrima* and *B. solidaginifolia* Gray, or *B. longifolia* Wats., and *B. multiflora* Kellogg, now remotely placed in sections II and V, respectively, this is one of the most poorly studied divergencies of the genus.

The two shrubs, *B. glomerata* and *B. hebecarpa*, if they are separate entities, placed by Robinson near the beginning of *Coleosanthus*, seem truly a connecting link with those above and the ones to follow. This is so, by foliar characteristics including venation and trichomes as well as karyotype. To them we would add *B. Palmeri*, which had been placed in the BACCHARIDEAE. Its karyotype was a complete misfit with the four others of that subsection examined, as was the coriaceous leaf. By this texture as well as the ovate leaf and the similarity of trichomes, it comes close to *B. glomerata* and *B. hebecarpa*. Its geographic range would appear to be a northward extension beyond Morelos, Guerrero, and Jalisco, where the other two occur, through Durango to Coahuila.

SECTION BULBOSTYLIS, SUBSECTION COLEOSANTHUS.

At the bottom, as the nearest present-day approach to the ancestral, would come the most woody *B. argyrolepis*, and shrubs like *B. pacayensis* and *B. adenocarpa*, with equally long chromosomes, in a somewhat broadened subsection *Coleosanthus* of section *Bulbostylis*. This would also include perennial herbs, previously in *Eubrickellia*, as *B. peninsularis* and *B. Wislizeni*, which by their karyotypes as well as technical characters would better come in a reticulate than linear arrangement. As well the two species, *B. amplexicaulis* and *B. betonicaefolia* would be associated along with the latter because of the similarities discussed above.

RETICULATAE. The connecting link referred to under the previous species, would bridge to the subsection *Reticulatae*, by which name the group is significantly differentiated. The leaves vary from linear- to lanceolate-oblong and have two submarginal veins strongly persistent to the tip which with smaller veins result in a somewhat arcuate venation. Those collected have in common a thick underground caudex which by its woodiness might merit an earlier position. It is erect, however, and not confused with the horizontal rhizomes of the first group.

Next to those studied, *B. venosa*, *B. oliganthes*, *B. reticulata* and *B. verbenacea*, and three other obviously similar ones already placed in this group, would be placed *B. cuspidata* and *B. lanata*. The broader, strongly reticulate leaves with distinct submarginal veins is a characteristic common to them both and not found as marked in others with non-entire margins. The narrower leaf of the one collection of *B. lanata* was no wider than seen in a larger leaf of *B. verbenacea*. It would be better expressed, though, to say that with these two, the previous members would be included as *Reticulatae*, since *B. lanata* with the larger heads and broader leaves would probably have been less advanced than those with smaller heads and narrower leaves. The karyotypes have been described above as being in good agreement. It will be noticed that by the inclusion of *B. cuspidata* here, and the previous disposition of *B. amplexicaulis* and *B. betonicaefolia*, along with *B. Wislizeni*, the subsection *Amplexicaules* has been stripped of all but one species, *B. subsessilis* Robinson. The one collection of it from Baja California has more rounded ovate leaves than *B. betonicaefolia* or *B. amplexicaulis*, but strongly resembles them in membranaceous texture and might be included with them.

Brachiatae. Though only *B. Coulteri*, one of eight species having petiolate triangular leaves, has been studied, there seems good reason to leave a group which is technically so similar. Robinson had provided in the key for possible confusion with *B. grandiflora*, but his separation has been well justified in the karyotype, as compared with at least *B. Coulteri*. In length, the chromosomes are smaller than *B. grandiflora* and very similar to those of *Reticulatae*, from which, however, one pair with satellites distinguishes them.

Microphyllae. Pending study of *B. Watsoni*, now in this group with *B. Nevinii*, *B. microphylla* and *B. scabra*, this group stands as one of small leaved, shrubby xerophytes and the karyotype seen in three of them is that of the so-called general.

Incana. Because the strictly desert form, *B. incana*, of extremely isolated distribution in southern California and Nevada, has an individual tomentum of long, thin-walled, almost unseptate trichomes, of which a few have side branches, this species stands by itself. This was thought to be true of its karyotype as

well as the very large achene. After receiving a complete specimen of *B. Greenei*, it was found to compare with *B. incana* as follows: Both were perennial herbs, though the base of *B. incana* was described as woody; leaves were ovate rather than ovate-orbicular and very short petiolate rather than sessile; both had heads ca. 60-flowered, terminating branches of a sub-corymbose inflorescence and the achenes were 7 and 10 mm. long. The distinctive characters of *B. Greenei* were the long, outer, herbaceous phyllaries, which like the stem and leaves were covered with the biseriate glandular trichome in contrast to the long non-glandular. Thus they differed in their types of pubescence just as the otherwise closely related members of the subsection Microphyllae. Since the biseriate glandular organ is present in the leaves of other species either elevated as a trichome or depressed in the punctate condition, the differences in technical characters were not great. The two species appear to be more closely related than either approaches any other. Both are xerophytes, restricted to different areas. The similarity of their karyotypes bears out their juxtaposition in the chart.

parvulae. With the appearance of slightly shorter chromosomes in *B. dentata*, the evolutionary trend of reduction seems to have begun by an overall shortening. Of the perennial herbs of somewhat lanceolate leaves, belonging to the subsection *Parvulae*, only the two, *B. brachyphylla* and *B. dentata*, have come under investigation. From the karyotype, as well as unusually delicate trichomes contributing the puberulence of *B. dentata*, it may be that a distinctive line of evolution is indicated which the study of other species would confirm.

bacchardeae. The more discussed species, *B. veronicaefolia*, *B. californica*, *B. desertorum*, and *B. laciniata*, assembled in this group by the taxonomist, will not differ too much now from other subsections in having represented species of 18 to 62, 8 to 18, 8 to 12 and 9 flowers, respectively. The soundness of his judgment in placing together four species which have been found to have such similar karyotypes, yet so distinctive from the majority, as well as the more moniliform trichomes and small achenes, is another proof of the great genius of Robinson.

floribunda and rusbyi. The karyotypes of *B. floribunda* and *B. Rusbyi* suggest a close relationship of these two species.

It is notable that Gray (1884), when describing *B. Rusbyi*, spoke of its having the habit of *B. floribunda*, except that the inflorescence was thyrsoid paniculate whereas that of the latter had been described as a corymb of many heads. The leaves of both are given as alternate, deltoid- or rhombic-ovate. That *B. floribunda* has glandular trichomes, and the other sessile glands and attenuate trichomes, is not more different than has been found within varieties of the same species. For in *B. adenocarpa*, *B. secundiflora*, and *B. Palmeri*, having so-called glandular and non-glandular varieties, the latter still have the sessile glands. Heads are of the same size, being given as 16- and ca. 15-flowered. The achenes of both are small. Gray had described both as herbaceous. Robinson's adjective "suffrutescens," for *B. floribunda* suggests a tendency to the shrubby. It is evidently a little stronger, and a little taller, up to 1.5 meters in contrast to 1 meter, and has, as well, a more ample inflorescence than *B. Rusbyi*.

These two species had been placed as the first and the last of subsection *Coleosanthus*, characterized by larger petiolate leaves than the previous subsection *Baccharideae*. As the latter are shrubby xerophytes, the two perennials hardly fit in there any better than they do with the otherwise entirely Mexican and Guatemalan species of *Coleosanthus*. Yet the karyotypes of *B. floribunda* and *B. Rusbyi* resemble strikingly those of two of the *Baccharideae*, *B. californica* and *B. laciniata*. The two perennials are cohabitants with *B. californica* as can be seen by the sources of accessions in table I. All three have been studied from the same county, Pima, Arizona, and two of them, *B. californica* and *B. Rusbyi*, from the same county in New Mexico, Cochise. While *B. floribunda* has only glandular trichomes, on *B. Rusbyi* the same moniliform type was found as in *B. californica* and *B. laciniata*. It would seem that in these two herbaceous perennials evolution had taken another step ahead. Perhaps from a common earlier form, which had already acquired the karyotype of reduced chromosome size, there was a divergence from the shrub to the perennial. There is no place in the genus, among the species studied, where the parallelism of karyotype with perennial and shrub is as evident. Yet the genus consists largely of both these growth-forms and it must have taken place many times.

For the present we have placed them by themselves on a side branch next to the *Baccharideae*.

SECTION LEPTANTHODIUM. The two species just discussed suggest an even more exciting stepping stone to the few annuals occurring in this genus. Though there is only the one well-known and widely spreading species, *B. diffusa*, Robinson described a second, *B. filipes*, from limited material of two locations and from specimens lacking the base. He placed it in this section pending confirmation of the root, because of similarity to *B. diffusa*. Both have broad ovate leaves and heads of 8 and 14 flowers, with the new species varying in clavellate rather than the filiform style, which is singular to the whole genus. From examination of the pappus these two have equally delicate pappus setae, on which the barbules are arranged tristichously rather than somewhat distichously as in the majority of species. It is obvious that there have been many gene changes in the major break from perennial to annual. However, the karyotype of *B. diffusa*, with short chromosomes, finds a close approach in those of the two perennials, and the shrubs with which the comparisons are here made.

Summary

The chromosome number was obtained in 41 species of *Brickellia*, representing the genus fairly well geographically as well as sectionally. Although some species occur well into the tropics they are limited to the plateaus, except the annual *B. diffusa*, and thus really grow under temperate rather than tropical conditions. In this study about equal numbers of shrubs and herbaceous perennials were included as well as one annual. Since all had 2n = 18, no correlation of chromosome number with the amount of woodiness was found in this genus.

Meiotic divisions were examined in 21 of the species plus varieties. In 4 plants, representing as many species, out of a total of 26 accessions, irregularities were found usually associated with structural hybridity. These included lagging chromosomes at I metaphase and chromosome bridges and fragments on I telophase spindles, characteristic of inversions. The irregularities were found in Mexican species, three of them belonging to subsection *Coleosanthus*, where intermediates have been recog-

nized. The irregular meiosis of the fourth species, *B. reticulata*, offered a strong contrast to the regular seen in three other closely related species. This does distinguish it from another species from which it has been considered doubtfully distinct.

Somatic divisions were seen in 71 accessions representing 39 species. In 33 perennial herbs and shrubs and the one annual, the karyotypes were studied with especial care and compared. One chromosomal complement, or a complement so closely approaching it that it could not be distinguished, consisting of long, medium and short chromosomes, was common to 14 perennial species. Since so many species had a similar general karyotype, genic changes must be largely responsible for speciation.

Evidence was found for considerable reduction in the length of the chromosomes in a minority of species and this is believed to mark a major trend in the evolution of the genus. In one species there was a tendency for all of the chromosomes to be shorter than in the general type. Eight species had no chromosomes longer than those of the medium class but had in addition other unusually short ones. The one annual had a karyotype somewhat similar to these. In contrast to these nine species in which the karyotypes had a smaller than average amount of chromatin, there was evidence in eight species for a greater than average total of chromatin material. The karyotypes of two species consisted only of long and medium chromosomes and in six others there was only one pair of short chromosomes, rather than two pairs.

No direct evidence was obtained which would explain the great variation in length of the chromosomes, although there were indications of possible loss of small segments.

Only three species were found to have a pair of satellite chromosomes, one having an otherwise general karyotype and the other two, a karyotype with short chromosomes. Generally there was a lack of evidence of increasing asymmetry of chromosome structure with advancing evolution.

Since the single annual has short chromosomes, there appears to be a parallelism between the reduction of chromosome size and the length of life cycle. Others with short chromosomes included four herbaceous perennials and four of subsection *Baccharideae*, consisting of shrubby xerophytes. The karyotype

with the longest chromosomes was found in a small group of perennials with exceptional fleshy rhizomes which suggest specialization. Among those with karyotypes next greatest in chromatin content were shrubby species, of which one is probably the largest and the most woody of the genus. This may be the nearest present day approach to the ancestral type.

Although the correlation is not complete, along with the trend to reduction in length of life cycle and chromosome size, goes a somewhat parallel reduction in achene size. At least, the species which have the longest chromosomes are among those having the largest achenes and those which have short chromosomes are, with two exceptions, among those having the smallest seeds. The shortest of all achenes were found in the annual species and these too, proved to have the greatest longevity of any of those tested. To a considerable extent there has also been a correlation between reduction of the number of florets per head and size of plant, but there are exceptions.

From a microscopic examination of leaves of species thought to be similar in other technical characters, additional support of relationship was found in the similarity of their trichomes. Also, several instances of correlation were found between the kind of trichomes and the chromosomal complements of the species. For example, the same moniliform type of trichome which occurred on species of the *Baccharideae*, having short chromosomes, was also found on one of the two perennial species with a similar karyotype, the other perennial having no non-glandular trichomes. Furthermore, *B. Palmeri*, which was found to have a karyotype unlike the other species of the *Baccharideae*, did not have a moniliform trichome. Instead, it was similar to that of another species and thus strengthened the inclusion of *B. Palmeri* with that species in a different subsection

The development of the larger glandular trichome, seen in some species and varieties by macroscopic observation, was traced from the depressed glands which are very characteristic of the genus.

This glandular trichome on a stalk of biseriate cells is but an expression of the outgrowth of the depressed gland, consequently no correlations were found with specific karyotypes.

Finally from a combination of taxonomic characters and karyo-

typic variations an attempt was made to arrange the species studied according to their probable evolutionary relationships (see chart, fig. 89).

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A New Color Form of Triosteum angustifolium.—In the process of monographing the caprifoliaceous genus *Triosteum*, the author was somewhat puzzled by two specimens resembling *Triosteum angustifolium* L. collected by Dr. C. C. Deam 797, May 13, 1906, from Franklin County, Indiana. They were labeled *Triosteum aurantiacum* Bicknell, but the hispid-ciliate sepals, the long bracts, the strigose upper leaf surface, the leaf-shape, and the general character of the plant indicates that it is not *Triosteum aurantiacum*. Later while examining specimens from Missouri, two more sheets resembling *Triosteum angustifolium* were found labeled *Triosteum aurantiacum* with a note that the flowers were orange. The plants were collected May 9, 1913, on rich hillsides, Jerome, Phelps County, Missouri, by John H. Kellogg.

On April 26, 1953, in a woodland near Karnak, Pulaski County, southern Illinois, three plants of a red-flowered *Triosteum* were discovered growing within a few feet of the typical lemon-yellow-flowered plants. Two of these plants were collected, one deposited in the herbarium of the University of Illinois and the other planted in a yard at Urbana, Illinois. Further search of the woods at this date and again on May 9, 1953, revealed no other red-flowered plants. The typical *Triosteum angustifolium* was scattered throughout the red oak and hickory woods in rich leaf mold.

A careful comparison of the typical form with the red-flowered form showed no differences other than the flower color except that the general habit of the red-flowered form is more robust. Herbarium specimens of *Triosteum angustifolium* from other localities, however, match the red-flowered form in size and general appearance. The red-flowered specimens from Indiana are almost identical in size and shape with yellow-flowered specimens collected by Dr. C. C. Deam in the same locality, but on different dates. The color of the corolla is near jasper red according to Plate XIII of Ridgway's *Color Standards and Color Nomenclature;* it is much lighter than the reddish-purple that occurs in the other species and varieties of *Triosteum*. The possibility of a hybrid seems unlikely because no other species or varieties of *Triosteum* were found in the area.

It is interesting to speculate whether this is the *Triosteum hispidum* that Rafinesque described from Kentucky in 1836.

His description reads: "stem flexuose striate hispid, leaves sessile ovate spatulate acuminate smooth ciliolate, axils uniflore, flowers sessile, ovary hispid, calix smooth linear lanceolate—in the glades of West Kentucky with the last, [*Triosteum angustifolium*] but quite distinct by broader smooth leaves quite sessile, corol orange color." The sepals in the red-flowered form discussed above are hispid-ciliate on the margin exactly as those of *Triosteum angustifolium,* but Rafinesque omits this character in describing both *Triosteum hispidum* and *Triosteum angustifolium.* The label-data on the specimens from Missouri indicate that the corolla was orange as Rafinesque states for *Triosteum hispidum,* but the plants from Karnak (Illinois) have flowers that are more nearly red than orange. Rafinesque further states that the leaves of *Triosteum angustifolium* are slightly scabrous and the leaves of *Triosteum hispidum* smooth. I am not able to verify either of these characters in the specimens I have examined. Although the description of *Triosteum hispidum* varies slightly from the modern specimens examined, it seems probable that this red-flowered plant is the same thing that Rafinesque attempted to describe.

From an examination of 160 sheets of *Triosteum angustifolium* and about 600 sheets of other species and varieties of *Triosteum* only five specimens of this red-flowered plant were discovered. Fruiting specimens examined in July show no difference in the color, shape, or pubescence of the fruit. It is, therefore, proposed to treat this plant as a form of *Triosteum angustifolium.* This is the first flower-color form that has been described in the genus.

Triosteum angustifolium L., forma **rubrum** Lane, f. nov.—Haec forma a planta typica speciei corollis rubris recedit.

This form differs from the typical form of the species in having red corollas.—Growing near *Triosteum angustifolium* L. under a cover of *Quercus rubra* and *Carya ovata,* ½ mile west of Karnak, Pulaski County, Illinois, April 26, 1953, *Franklin C. Lane,* 1441, TYPE in Herbarium of University of Illinois, Urbana, Illinois.—FRANKLIN C. LANE, DEPARTMENT OF BOTANY, UNIVERSITY OF ILLINOIS, URBANA, ILLINOIS.

Two Unusual Plants in Essex County, Massachusetts.—In mid-July I found a number of plants of a *Verbascum* which seemed different from any that I had seen before. Some of the plants had yellow petals and some had white ones but otherwise they were similar. An outstanding characteristic was the dark red, almost mahogany-colored, beard on the filaments. These plants appeared in recently seeded ground near a new school house in Lynn not far from the Lynnfield line. The plants did not seem to fit into any of the species described in Gray's Manual. A search in the Herbarium of the New England Botanical Club resulted in the identification of the plants as *Verbascum nigrum* L., a species not included in the Gray's Manual. In the New England Botanical Club Herbarium there are only three specimens of this species, two from Jefferson, Coös County, New Hampshire and one from Milton, Norfolk County, Massachusetts. On the label of the Milton specimen collected in 1919 is the significant note added, "Flowers yellow, sometimes white." In the Gray Herbarium this species is represented by a number of specimens from European stations all the way from Sweden to the Alps.

An unusual *Geranium* appeared in July in the perennial garden of Mr. Charles C. Stockman of Newburyport, Massachusetts. This proves to be *Geranium nepalense* Sweet, var. *Thunbergii* (Siebold & Zucc.) Kudo which was reported for the first time in America by Mr. F. W. Hunnewell from Wellesley in 1945 (Rhodora 47: 219). However in Gray's Manual in the description the petals are given as violet while in this recent specimen the petals are definitely white with violet lines. Reference to the Herbarium specimens for petal-color was unsatisfactory as the dried petals had faded and no notation was given on the labels as to the original color. This is a Japanese variety of an Asiatic species.—Ralph C. Bean, wakefield, massachusetts.

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PINGUICULA VULGARIS L. IN NEW HAMPSHIRE

A. R. Hodgdon and Frederic L. Steele

Butterwort is known from two stations in New Hampshire. The junior author of this paper, as a case in point, collected it on Cannon Mountain in Franconia on May 30, 1948. An earlier record from this same place is the specimen in the New England Botanical Club Herbarium, collected by G. Ledyard Stebbins, on May 25, 1929, bearing the collection number 551. It occurs there in a limited area on wet ledges at the head of the talus slope. However, of perhaps greater contemporary interest because of the historic associations and the involved series of events and personalities leading to its rediscovery, is the Mt. Willard Station. In the Herbarium of the University of New Hampshire is a solitary, but well preserved, specimen of Butterwort from New Hampshire collected by C. H. Hitchcock, at "Hitchcock's Notch, White Mountains about 1875". Knowing also of a collection of Pinguicula from "Butterwort Flume, Mt. Willard" by Edwin Faxon in the Herbarium of the New England Botanical Club, the authors ventured to prepare a brief article on the subject for Rhodora. This was forwarded to Dr. S. K. Harris, who immediately called attention to Sweetser's comments on Hitchcock Flume and brief mention of Butterwort Flume in his "White Mountains" ed. 11, 1891. p. 152. However, Dr. Harris, thinking it possible with proper assistance to shed more light on the subject, talked with Professor A. S. Pease, who promptly recalled an article in the December, 1945 issue of Appalachia entitled "Mt. Willard Ramblings" by Henry E. Childs. A map on page 446 shows both Hitchcock and Butterwort Flumes and the text deals in part with the failure of Mr. Childs, while exploring Mt.

Willard, to locate anything suggesting Butterwort. He was, however, fairly clear in his directions to Butterwort Flume and he also pointed out that Hitchcock himself in his Geology of New Hampshire had published a map showing both flumes.

An inspection of C. H. Hitchcock's Geology of New Hampshire, Vol. II, disclosed the aforementioned map opposite p. 170 and a rather thorough discussion of Mt. Willard on pp. 165–173 with consideration of the Flumes on pp. 171–173. Hitchcock wrote as follows concerning Butterwort Flume. "The first flume is only a short distance beyond. It is not perceptible from the top of the cliff. Its course is determined by a trap dyke dipping 65° S, 10° W, about 5 feet wide. For about 200 feet the excavation into the mountain may average a depth of twenty feet and the inclination of the floor is too steep to allow one to descend or ascend in it . . . In this flume, I found, growing rather sparingly, a beautiful flower, the *Pinguicula vulgaris* or Butterwort. It is said to range from "western New York to Lake Superior and northward." None of the botanists who have explored the White Mountains for plants speak of it; so it must have escaped their notice. In memory of this plant, therefore, I will call the chasm the "Butterwort Flume" to distinguish it from the one farther north."

Considering themselves well fortified with the above information the authors in company with Alexander Lincoln, Jr., on June 21, 1953, proceeded rather directly and with little of adventure to the base of Butterwort Flume where the first Pinguicula was encountered. From this point on, however, the senior author, who is not adapted to rock climbing, had to be assisted. This point is mentioned not to entice rock climbers to the place, for the flume would present no real challenge to them, but to discourage the uninitiated who would run severe risks, particularly if the rocks were wet. In the nearly 72 years since the last reported visit by a botanist, that of Faxon in 1881, the Pinguicula seems to have held its own. It was in full flower at the time of our visit.

The junior author, becoming separated from the other two members of the party, negotiated the other longer chasm, Hitchcock Flume, on the same face of Mt. Willard, but farther to the north and higher up. This is a deep narrow flume with vertical

walls, too dark for much vegetation to grow. No Butterwort was seen, which makes it entirely likely that the University of New Hampshire specimen was collected also from Butterwort Flume and not from the one now called "Hitchcock Flume."

In the Jesup Herbarium at Dartmouth, there is a specimen collected at "Butterworth Flume, Mt. Willard, New Hampshire, 1875" by Hitchcock. According to A. S. Pease, in a recent communication to the authors, in the Amherst College Herbarium (now deposited at the University of Massachusetts), there is a sheet with the following inscription, "Pinguicula vulgaris L. Mt. Willard, New Hampshire, July 1, 1875, Hitchcock's Ravine, a new discovery—Professor Charles H. Hitchcock." Presumably "Hitchock's Notch" and "Hitchcock's Ravine" on labels refer to Butterwort Flume and not to the true Hitchcock Flume.

In the Gray Herbarium, is a specimen of E. and C. E. Faxon from Butterwort Flume (the same date and probably the same collection as the New England Botanical Club specimen of E. Faxon) and one from the collection made by Agassiz, with the none too helpful information on the label "White Mountains of New Hampshire."

On July 26, 1953, Mr. Theodore W. Wells, who teaches at Milton Academy, ascended Butterwort Flume with a companion. His comments, in part, in a letter written to the senior author are worth recording here, "The lower two-thirds of the Mt. Willard crevice are filled with stream detritus and, therefore, present no problem to the climber. The final third, however, is steeper and contains nothing but solid traprock, made more treacherous by moisture and plant encrustations. At the base of this passage—Butterwort Flume proper—*Paronychia argyrocoma* var. *albimontana* may be found on the north side, c. el. 2200 feet. In the flume one at once observes that the trap dike dips about 75° S, such, that the south wall is overhanging and resultingly darker and damper. Even from the base of the flume the conspicuously yellow-green leaves of Pinguicula are seen on the south wall and in the bed of the stream. The plant increases in frequency up the hundred or so feet of the flume, which terminates abruptly in a cave with a prominent caprock (c. el 2300 feet). The presence of Pinguicula, a calciphile, is

probably explained in part by the fact that the chemical erosion of the calcic feldspars and ferromagnesian minerals in the basalt by water and carbon dioxide yields some quantity of calcium carbonate."

In summary the following collections of Butterwort have been made at Mt. Willard. 1. Hitchcock, 1875 (specimens at the University of Massachusetts; University of New Hampshire and Dartmouth College); 2. E. and C. E. Faxon (specimens at the Gray Herbarium, and the New England Botanical Club Herbarium, the latter with only the name of E. Faxon on the label); 3. Hodgdon, Steele and Lincoln, June 21, 1953; 4. Theodore Wells, July 26, 1953.

The chronological picture would now be clear except for the Agassiz specimen, in the Gray Herbarium. As Professor Pease has pointed out to us, Louis Agassiz died in 1873, two years before Hitchcock's classical visit to Butterwort Flume. Was he aware of the Mt. Willard Pinguicula before Hitchcock's time, or did Agassiz discover the station of Pinguicula at Cannon Mountain which is after all more accessible than that in Crawford Notch?

In our opinion the statement of range of *Pinguicula vulgaris* on p. 1308, in the new Gray's Manual is misleading in that it seems to indicate that this plant is not found in the state of New Hampshire. We suggest that the range given on page 1308 in the "Manual" be amended following the words "and locally to" to read "n. New Hampshire" following which presumably the statement of range would continue as there given.—UNIVERSITY OF NEW HAMPSHIRE, DURHAM, NEW HAMPSHIRE AND ST. MARY'S-IN-THE-MOUNTAINS, LITTLETON, NEW HAMPSHIRE.

TAXONOMIC COLLECTIONS OF VASCULAR PLANTS IN THE SOUTHEASTERN STATES—THEIR ABUNDANCE AND RELATION TO PRODUCTION OF FLORAS

Wilbur H. Duncan

In planning for extensive collecting in the Southeastern States during 1953, much attention was given to the matter of where collections should be made. The location of poorly collected areas was thought to be of considerable importance. Published records of distribution were examined for several species but no definite over-all pattern was discernible. Finally a composite map of dots was prepared to indicate citations by county of specimens from the Southeastern States, including Arkansas and Louisiana, in taxonomic papers covering 62 species in five genera. The genera were *Ruellia* (Fernald, 1945), *Selaginella* (Clausen, 1946) *Liatris* (Gaiser, 1946), *Tephrosia* (Wood, 1949), and *Sabatia* (Wilbur, 1952). Distribution data for *Sabatia* were provided by Dr. Robert L. Wilbur from his unpublished manuscript and are gratefully acknowledged.

Only one dot was placed in a given county for a given species. Several collections of one species from each of such counties as Dade, Duval, and Hillsborough in Florida are represented, therefore, by one dot in each county.

Graphic analysis of the final dot map (Figure 1) indicates clearly a number of relatively poorly collected areas [e.g.; (1) most of Mississippi, Louisiana, and Tennessee; (2) large areas in Arkansas, Alabama, Georgia, and South Carolina; and (3) smaller areas in North Carolina]. Florida appears relatively well collected throughout.

One should keep in mind that the five genera are largely southeastern in distribution and that the number of dots in a given area probably should not be compared absolutely with that of certain other distant areas, e.g., western Tennessee and northern Florida.

In making an analysis of the dot map, one should also take due consideration of recent intensive collecting in certain areas, (e.g., A. J. Sharp and R. E. Shanks in Tennessee; William Fox, R. K. Godfrey, and others in North Carolina; Robert Thorne and

myself in Georgia). These collections were partly available or not at all to Gaiser, Fernald, Clausen, and Wood.

A number of counties with relative large collections, however, are adjacent to counties, or larger areas, with little or no recorded collections. Examples of such counties are Rapides and Natch-

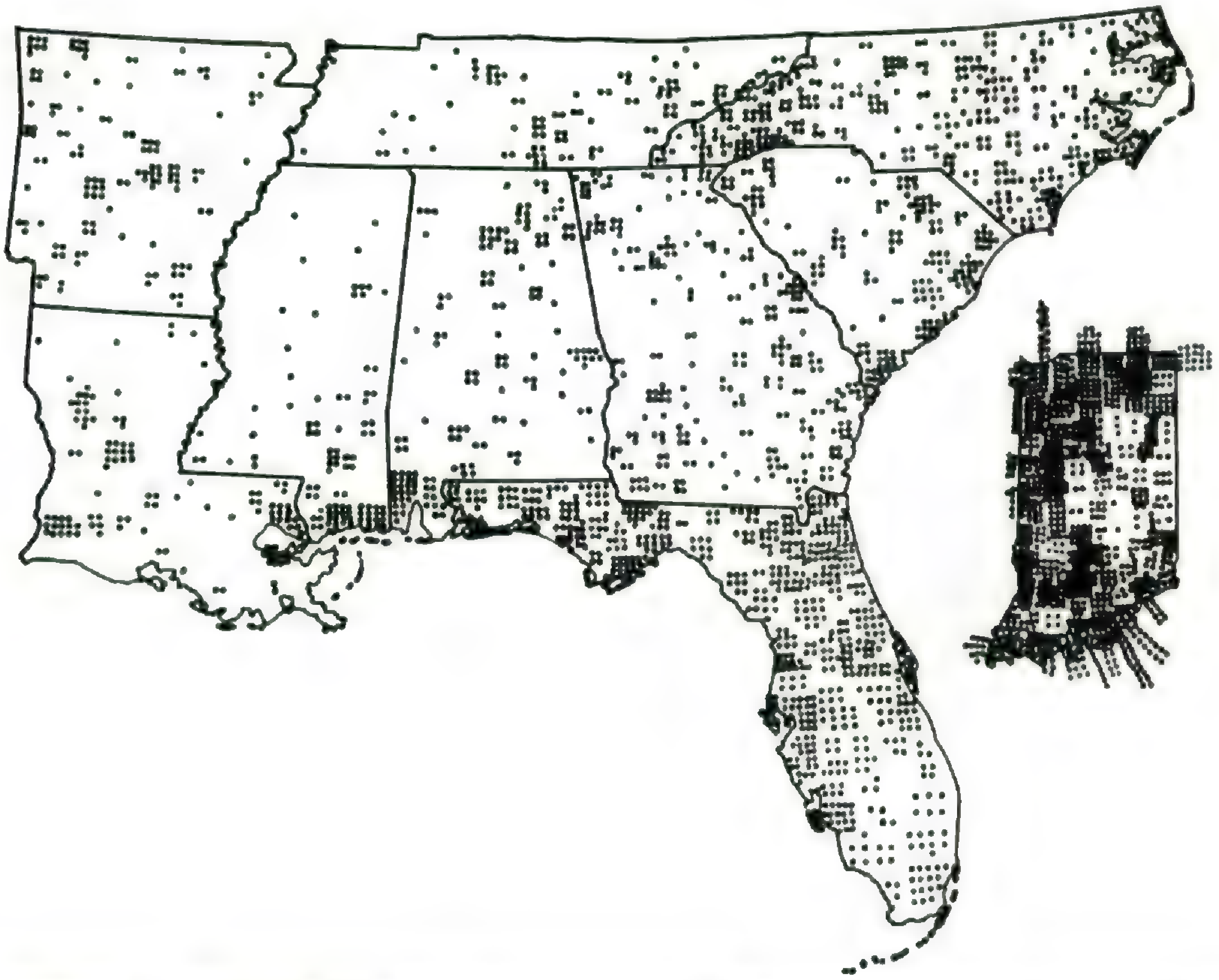

Figure 1. Map of nine southeastern states and Indiana showing by dots the number of species (out of 62) reported for each county.

itoches in Louisiana, Cullman and Lee in Alabama, Richmond and Floyd in Georgia, Davison and Knox in Tennessee, and Darlington and Anderson in South Carolina. Such concentrations are frequently correlated with locations of educational insititutions and/or with localities where one or a few persons made concentrated collections. Analyses of such relationships would undoubtedly be interesting, but they are not, however, within the scope of this paper. The abrupt shifts in numbers of collections recorded from given counties to adjacent counties in my opinion usually reflect existing differences in the amount of collecting of all species of vascular plants.

Graphic analysis of the data (Figure 1) readily demonstrates that Florida is the best collected state. The relative standing of the other states is not so clearly evident. The dots for each state, therefore, were totaled and the average number per county calculated. It is assumed that if all other factors were equal, the smaller the county the fewer the number of species collected in it. To compensate for this an "area factor" was computed by dividing the average area of the counties for each state into the average area of the counties in Florida whose counties had the greatest average area. This "area factor" for each state was then multiplied by the average number of collections per county for that state to give the "corrected average number of collections" per county which we shall use in establishing the position for each state. The data are presented in Table 1, Florida presenting the best record and Mississippi the lowest. The differences between the "corrected average number of collections" for Florida and each of the other states are probably significant. The difference between the values for Mississippi and Louisiana, for example, probably is not.

At this point in my analysis of the data a question that has frequently come to my mind, and undoubtedly to other taxonomists, again became prominent. Are there sufficient numbers of specimens upon which to base work on good modern floras of the various states or even of the whole Southeastern States? One way to analyze this question is to compare the present data for the Southeastern States with similar data from some area having a good flora. It is conceded by many that Deam's (1940) Flora of Indiana is probably the best state flora produced. The five genera included in the present analysis are not, however, well represented in Indiana, and could not, therefore, be used in making the comparison desired between Indiana and the Southeastern States. It was decided to select 62 species from Deam's "Flora" and make a comparison with them.

The "Flora" was opened near the middle and the first large genus that was encountered, *Desmodium*, was chosen. Certain other genera that followed were also included. No attention was paid to the maps until after a total of 62 species was listed for compilation. The final list included all species in *Desmodium* (16), *Lespedeza* (11), *Lathyrus* (4), *Apios* (1), *Oxalis* (6), *Polygala*

TABLE I

Average Number of Collections per County Cited in Monographs of 5 Genera, Including 62 Species, for Each of 9 States, Data for Indiana Being Based on Another 62 Species. The Area Factor, a Value Compensating for Relative Average Size of Counties; Corrected Average Number of Collections; and Total Number of Species Reported Are Also Given.

State	No. of Counties	Average Number Collections per Co.	Area Factor	Corrected Average Number Collections	Total Number Species Reported
Florida	67	9.3	1.00	9.3	41
N. Carolina	100	3.5	1.66	5.8	30
S. Carolina	46	3.5	1.30	4.6	32
Georgia	159	1.6	2.36	3.8	41
Alabama	67	2.3	1.14	2.6	35
Arkansas	75	1.7	1.23	2.1	16
Louisiana	64	1.7	1.15	2.0	31
Tennessee	95	1.0	1.97	2.0	17
Mississippi	82	1.1	1.50	1.7	23
Indiana	92	12.6	1.22	28.0	62

(8), and *Euphorbia* (16). A composite map for Indiana was prepared for the 62 species (Figure 1). Dots were so abundant in many counties that it was necessary to place dots adjacent to the counties and outside of the state boundaries. It appears that the average number of specimens per species upon which Deam's Flora was based much exceeds that of any Southeastern State. The "corrected average number of collections" per county for Indiana is 28.0 over 3 times that for Florida, 7 times that for Georgia, and 16 times that for Mississippi.

In comparing the amount of material from Indiana with that from any southeastern state, the number of species (out of the 62) that might be expected to occur in each state should be considered. This number is undoubtedly greater in every instance than the number of species reported per state (Table 1). Even assuming that no more than 16 species will be reported for Arkansas, which is the state with lowest number, a comparison of the ratios of 16/2.1 for Arkansas and 62/28 for Indiana indicates that there are only one/third as many specimens available for study in Arkansas as compared to Indiana.

These and other data have convinced me that more collecting must be done in most parts of the Southeast before new Floras of the area should be attempted. Perhaps others will have a different opinion. There probably is little doubt, however, that many areas in the Southeast are very poorly represented by collections. It is urged, therefore, that monographers and others studying plant material of species whose ranges include the Southeast be prudent by obtaining for study the maximum number of specimens from this area. Adequate specimens from this area are not now available in the major herbaria of the United States. Recent intensive collections, now included in herbaria at several of the southeastern educational institutions, may provide a good beginning towards eliminating the problem of too few specimens for study. The effect of these recent collections on the dot map is evident to me in the composite map not shown for the species of *Sabatia*. A majority of the dots (Figure 1) in Southwestern Georgia represent collections of *Sabatia* by Robert Thorne. Thorne's collections from Southwestern Georgia are absent or mostly so from the other species included in the map. No matter how few specimens a given

institution in the southeast may be able to provide in response to a request for a loan, it is a duty to send them for study upon request, if for no other reason than the fact that one specimen from this area means much more, perhaps 5 to 15 times as much, as would a specimen, e.g. from Indiana, New York, or Massachusetts.—DEPARTMENT OF BOTANY, UNIVERSITY OF GEORGIA, ATHENS, GEORGIA.

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Fernald, M. L. 1945. *Ruellia* in the Eastern United States. Rhodora **47**: 1–38, 47–63, 69–90.

Gaiser, L. O. 1946. The genus *Liatris*. Rhodora **48**: 165–183, 216–263, 273–326, 331–382, 393–412.

Wilbur, Robert L. 1952. A revision of the North American genus *Sabatia* (Gentianaceae) 287 p. unpublished thesis, University of Michigan.

Wood, Carroll E., Jr. 1949. The American barbistyled species of *Tephrosia* (Leguminosae) Rhodora **51**: 193–231, 233–302, 305–364, 370–384.

Nomenclature of American Mountain-ash.—There are two species of native mountain-ash occurring spontaneously in eastern United States. The one with acuminate leaflets and small fruits was first described from Pennsylvania by Marshall in 1785 as *Sorbus americana*. The other species, with acute leaflets and larger fruits, was first described as *S. aucuparia* var. β by Michaux in 1803. Pursh in 1814 treated it as a species, also named *S. americana*. This was transferred to Pyrus, as *P. americana*, by De Candolle in 1825. In 1902 it was treated by Sargent as *P. americana* var. *decora*, and in 1906 was raised to specific rank as *Sorbus decora* (Sarg.) Schneider. Although it has been clearly pointed out[1] that *Pyrus americana* DC. does not refer to the same species as *Sorbus americana* Marsh., yet followers of "Gray's Manual of Botany" continue to refer to the American Mountain-ash as *Pyrus americana* (Marsh.) DC.

It is not the purpose in this short article to urge the retention of Sorbus for the mountain-ashes, Pyrus for pears, or Malus for apples (see L. H. Bailey in Gentes Herbarum **8**: 40–43, 1949), because the basic morphological facts (see Decaisne in Nouv.

[1] Journ. Arnold Arb. **20**: 11–16 (1939).

Archiv. Mus. Hist. Nat. Paris **10:** 113–192, 6 plates, 1874) as well as prevailing botanical and horticultural usage for the past two centuries render such advocacy unnecessary. The prime purpose here is to point out to those who wish to treat the American mountain-ash as a pear-tree that there appears to be no choice but to adopt the binomial *P. microcarpa* (Pursh) DC. (1825). The earlier name for this species, *Sorbus micrantha* Dum.-Cours. is unavailable under Pyrus because of the existence of *P. micrantha* Franch. & Sav. (1879) for a species of Japan.

In view of the fact that the nomenclatural history of these two species is somewhat involved and is in need of additional clarification, it may be desirable to repeat some of the more important evidence. As previously noted, *Sorbus americana* was first described by Marshall in 1785. While Marshall's description is not as definite as may be desired, there is scarcely any doubt as to the identity of his plant as it is the only native species of Sorbus occurring in Pennsylvania, where Marshall had his garden, and from where, presumably, he obtained his specimens. In 1803, Michaux (or his editor), overlooking or ignoring Marshall's work, characterized the two native northeastern American mountain-ashes as varieties α and β of *S. aucuparia* L. The variety α was said to have "foliis acuminatis," and habitat "in excelsis montibus Carolinae." This is obviously *S. americana* Marsh. The var. β was characterized by "foliis sensim acutis," and the habitat "in Canada et circa lacum Ontario." Plainly, this is the northern shrub we now call *S. decora*. In 1809 Willdenow published as a newly named species *S. americana,* citing "*Sorbus aucuparia* Mich." as a synonym and giving the habitat "in montibus excelsis Carolinae," evidently quoting from Michaux. In doing this he possibly was unaware of the earlier publication of *S. americana* Marsh., or at any rate he did not refer to it. The var. α and var. β of Michaux were evidently regarded as identical.

Pursh in 1814 was the first to recognize the fact that there are two separate species native to northeastern North America, each distinct from the European *S. aucuparia* L. The northern plant with acute leaflets and large fruits Pursh called *S. americana,* citing Willd. Enum. Plant. 520, from where he copied the description. To this description, however, he made the important

addition "foliolis acutis," citing *S. aucuparia* var. β Michx. as a synonym, and giving the habitat "In Canada and on some of the northern mountains." All this refers unmistakably to what we now call *S. decora* (Sarg.) Schneid., and confirms the fact that *S. americana* Pursh is not *S. americana* Marsh. It is interesting to note that Pursh appears to have copied from Willdenow the statement "Berries purple, not scarlet as in the European species." Pursh designates the other native eastern North American tree (the one with acuminate leaflets, small fruits, and a more southerly range), by the new name *S. microcarpa*. He cites *S. aucuparia* α Michx. as a synonym, gives the habitat and range "On the peaks of high mountains: New Jersey to Carolina," and adds the comment "This species is very distinct from the Canadian *Sorbus*." i. e., his *americana*, which, as previously pointed out, is *S. decora* (Sarg.) Schneid., but not *S. americana* Marsh. In 1825 A. P. De Candolle transferred these species to *Pyrus*, but the name *Pyrus americana* DC., designating the northern shrub with acute leaflets and large fruits, is based upon *Sorbus americana* Pursh, and therefore is not synonymous with *S. americana* Marsh. It belongs as a synonym of *S. decora*.

The principal bibliography of these two species is as follows:

SORBUS AMERICANA Marsh. Arbust. Am. 145 (1785); Willd. Enum. Pl. **1:** 520 (1809), pro parte. *S. aucuparia* var. α Michx. Fl. Bor. Am. **1:** 290 (1803). *S. micrantha* Dum.-Cours. Bot. Cult., ed. 2, **5:** 464 (1811). *S. microcarpa* Pursh, Fl. Am. Sept. **1:** 341 (1814). *Pyrus microcarpa* (Pursh) DC. Prodr. **2:** 636 (1825). *Pyrus americana* sensu Watson & Coulter in Gray, Man. Bot., ed. 6, 164 (1889), Robinson & Fernald in op. cit., ed. 7, 459 (1908), Fernald in op. cit., ed. 8, 760 (1950). Non (Pursh) DC. (1825).

SORBUS DECORA (Sarg.) Schneider in Bull. Herb. Boiss. II. **6:** 313 (1906). *S. aucuparia* var. β Michx., loc. cit., *S. americana* Willd., loc. cit., pro parte; Pursh, loc. cit. *Pyrus americana* (Pursh) DC., loc. cit. *P. sambucifolia* Watson & Coulter, loc. cit. Non Cham. & Schlecht. (1827). *P. americana* var. *decora* Sarg. Silva N. Am. **14:** 101 (1902). *Sorbus americana* var. *decora* Sarg. Man. Trees N. Am. 357 (1905). *Sorbus scopulina* sensu Hough, Handb. Trees U. S. & Canada 241 (1907), Britton in Britton & Brown, Illustr. Fl. N. States, ed. 2, **2:** 287 (1913). Non Greene (1900). *Pyrus sitchensis* sensu Robinson & Fernald in Gray, Man. Bot., ed. 7, 459 (1908). Non Piper (1901). *Pyrus dumosa* sensu Fernald in RHODORA **23:** 266 (1921). Non *S. dumosa* Greene (1900).—GEORGE NEVILLE JONES, UNIVERSITY OF ILLINOIS.

How Many Species of Vascular Plants Grow without Cultivation in Massachusetts?—Such a question is not easy to answer. The principal reason is that, in all its long history, the State of Massachusetts has never had a book produced to reveal to the interested person the composition of the flora covered within its exact boundaries.

In order to arrive at an estimate of the number of species present, I have used several sources each covering the flora of only a part of the State. The results of my tabulations are here given so that interested persons will not have to repeat the chore. The primary source is the series of "Reports on the Flora of the Boston District" begun in Rhodora in 1907 and continued until 1924. These "Reports" were prepared by the Committee on Local Flora of the New England Botanical Club. The composition of the Committee changed some over the years but two members, C. H. Knowlton and Walter Deane, were conspicuous in its activities throughout, and for most of the period of the "Reports" they alone made up the Committee.

The "Boston District" was liberally interpreted and, for the purposes of the "Reports," was considered to include eastern Massachusetts excluding Cape Cod. The area covered extended east from a north-south line along the eastern edge of Worcester County from the New Hampshire line to the Rhode Island boundary at Bellingham and north of a line from there east to the coast at Duxbury. In this area are found 2098 species of which 786 are introduced from outside the area, most of them from the old World.

The Flora of Berkshire County, Massachusetts, by Ralph Hoffman[1] was used to determine the species that occur in western Massachusetts not found in the flora of the "Boston District." There are 300 such species. The Ferns and Flowering Plants of Nantucket, by Eugene P. Bicknell, appeared in a series in the Bulletin of the Torrey Botanical Club beginning in 1908 and ending in 1917. These reports were checked against the "Flora of Berkshire County" and the "Flora of the Boston District" to determine how many species from Nantucket did not occur in the other two areas. There are 83 additional species. The Flora of the Elizabeth Islands, by John M.

[1] Proc. Bost. Soc. Nat. Hist. **36**: 173–382. 1922.

Fogg, Jr.[2] was checked against the other three works but no species were found that were not included in at least one of them. A further check, using a list from Cape Cod, would have been advisable but a flora for that area comparable to the others could not be found.

From the above procedure, an estimate of 2481 species of plants growing within the boundaries of Massachusetts was arrived at. In a series of cross checks, the introduced plants, when they did occur in western Massachusetts or on Nantucket, also appeared in the "Flora," so that the figure of 786 obtained from the "Flora of the Boston District" may be safely used to estimate the number of indigenous species within the State. There are approximately 1675 indigenous species. In other words, about 70% of the species now in our flora are native and about 30% are introduced from elsewhere.—R. C. Rollins.

Cirsium Flodmani (Rydb.) Arth., f. **albiflorum**, forma nova.—In July 1952, when the author was collecting on the dry prairie about 10 miles WSW of Langruth, Manitoba, her attention was caught by a stand of snowy white thistles. It proved to be a white-flowered form of *Cirsium Flodmani* (Rydb.) Arth., which has not yet been named in botanical literature. No normal purple-flowered nor any intermediate-colored thistles were found in the vicinity, but aside from the white flowers the plants were typical for the species (cf. Ownbey, 1952).

Cirsium Flodmani (Rydb.) Arth. f. **albiflorum** f. nova: A typo differt in floribus albis. Specimen typicum in Herbario Univ. Manitobensis (Á. & D. Löve, no. 5672, 1952) conservatum.

The distribution of the form is not thoroughly known. Inside Manitoba it had previously been collected by Dr. H. A. Senn (coll. no. 6185) 6 miles west of Letellier in Manitoba (Frankton in lit.). There is also a collection from Tyvan, Saskatchewan (Coupland & Hubbard, 29-7-45), which has been reported as *C. plattense* by Tisdale & Budd (1948), but has later been revised to *C. Flodmani* at Ottawa (Frankton, in lit.; cf. also Budd, 1953). In the herbarium of the University of Wisconsin at Madison another so-called *C. plattense* (coll. Dr. H. Hapeman, June 10,

[2] Rhodora, 1930. [Contrib. Gray Herb. XCI].

1925 at Minden, Nebraska) has been corrected to *C. undulatum* (Nutt.) Spring. var. *megacephalum* (Gray) Fern. by L. H. Shinners in 1942, but the author is inclined to believe that also this plant belongs to the *albiflorum* form of *C. Flodmani*. The same herbarium also has two sheets of *C. Flodmani* from the Northwestern Collections of 1941 by J. F. Brenckle and L. H. Shinners from "two Medicine River bottoms, 10 mls. SE of Browning, Glacier Co., Montana, Aug. 7, 1941." One of these is the normal purple-flowered thistle, the other one is the white-flowered form. It is therefore assumed that the form, though rare, has a distribution similar to that of the species itself.

The locality of the Langruth specimens was very dry prairie, the leading plants of which were *Elytrigia Smithii* (Rydb.) Löve, *Bouteloua gracilis* (Hbk.) Lag., *Stipa spartea* Trin., *Muehlenbergia cuspidata* (Torr.) Rydb., *Panicum virgatum* L., *Potentilla Anserina* L., *Oxytropis splendens* Dougl., *Potentilla bipinnatifida* Dougl., *Orthocarpus luteus* Nutt., *Liatris ligulistylis* (Nels.) Schum., *Aster ericoides* L. and *Antennaria microphylla* Rydb.—DORIS LÖVE, THE HERBARIUM, DEPARTMENT OF BOTANY, UNIVERSITY OF MANITOBA, WINNIPEG, CANADA

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OWNBEY, G. B. 1952. Nuttall's Great Plains Species of *Cirsium: C. undulatum* and *C. canescens*. RHODORA **54**: pp. 29–35.

TISDALE, E. W. & BUDD, A. C. 1948. Three recent additions to the check list of Saskatchewan plants. Canadian Field Naturalist **62**: pp. 95–96.—

Volume 55, no. 659, including pages 325–348, was issued 4 December, 1953.

ERRATA

Page 17, line 31; for *Tectorum* read *tectorum*.
Page 52, line 35; *for* var. *read* forma.
Page 53, line 16; for *laurentianum* read *laurentiana*; for *Mackayi* read *Mackayii*.
Cover of No. 651; for *Heliauthus* read *Helianthus*.
Page 84, line 7; for *longfolia* read *longifolia*.
Page 110, line 26; *for* compliment *read* complement.
Page 124, line 42; *for* oellected *read* collected.
Page 137, line 18; *for multifolra read multiflora*.
Page 155, line 20; *for* heretofor *read* heretofore.
Page 158, line 20; *for* vestitudioribus *read* vestiturioribus.
Page 201, line 37; *for* mm. *read* cm.
Page 227, line 33; *for* AMETHYSINUM *read* AMETHYSTINUM.
Page 228, line 30; *for* papes *read* pages.
Page 249, line 13; *for* ALEXENSIS *read* ALAXENSIS; before Cov. insert (Anderss.).
Page 253, line 29; for *Kuhniineae* read *Kuhniinae*.
Page 256, line 30; for *Kuhiineae* read *Kuhniiae*.

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